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Current Science



Vol. 26, No. 12

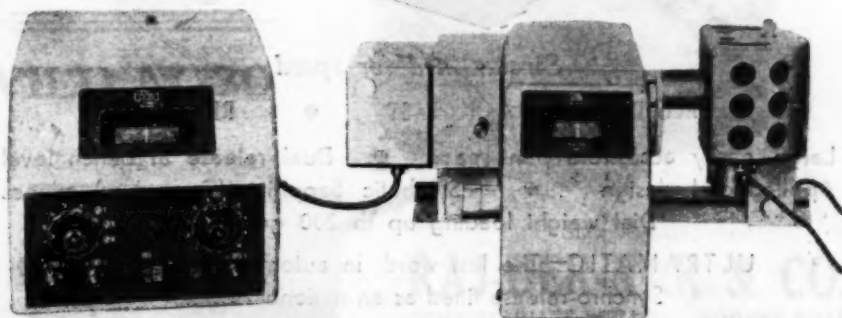
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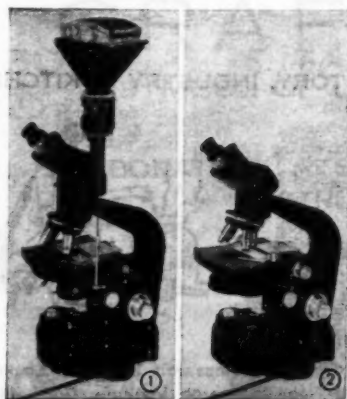
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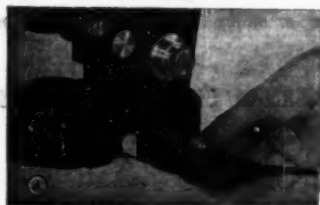


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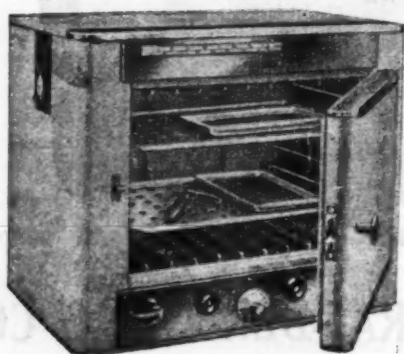
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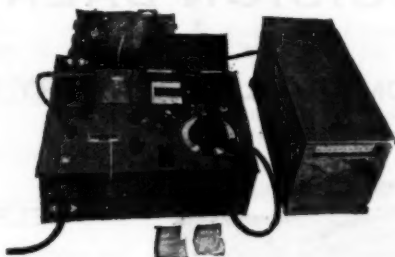
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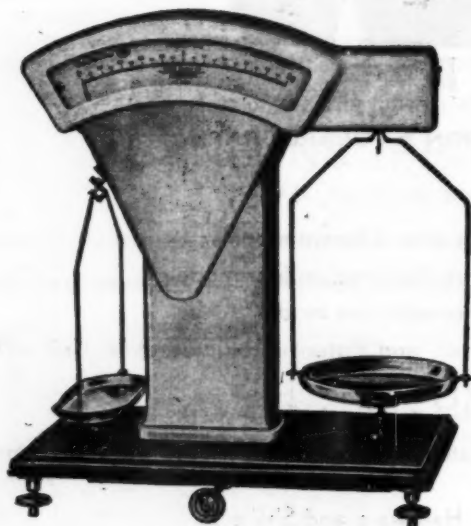
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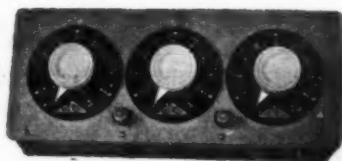
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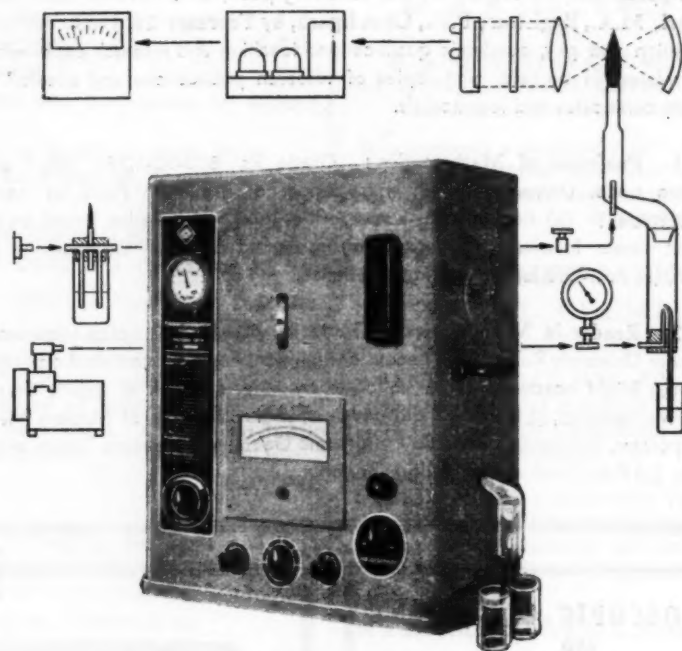
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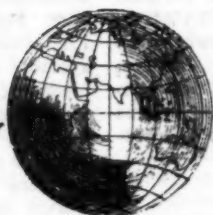
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RADIO ASTRONOMY

RADIO ASTRONOMY has blossomed into prominence in the last fifteen years, from its modest beginning in 1932; in which year Jansky made the epoch-making discovery that extraterrestrial radio waves reach us, from the galaxy. Despite the importance of Jansky's discovery, a decade was to elapse before the vigorous attack began on the subject of galactic radio waves as they are called now. In 1942, Southworth detected radiation from the Sun, and in the same year Hey discovered variable solar radiation of high intensity at metre wavelengths. The existence of the first known discrete source outside the solar system was inferred by Hey, and the source was located and shown to be of very small angular size by Bolton and Stanley in 1947. In 1951, an atomic line of hydrogen was discovered in the radio

spectrum of the galaxy by Ewen and Purcell, six years after its prediction by Van de Hulst. These are the pioneering observations of radio astronomy. Stimulated by the war-time development of high frequency radio techniques, and the discovery of solar radiation, the new science has expanded rapidly in the post-war period.

Our knowledge of the structure and nature of the universe has been gained almost entirely by the study of electromagnetic radiation that reaches the earth from the outside world. From the shortest γ rays to the longest radio waves, the electromagnetic spectrum spans a range in which the wavelength varies by a factor of 10^{18} . The more of this vast range of waves we can use in our studies, the greater will be the potential of knowledge available to us. But,

absorption and reflection by our own atmosphere severely limits the observable portions of the electromagnetic spectrum, and the atmosphere is transparent only to two wavelength bands, viz., the visible spectrum between 4×10^{-5} and 10^{-4} cm., and the part of the radio frequency spectrum between about 20 metres to 1 cm. It is the latter region that is of interest in radio astronomy.

RADIO TELESCOPES

Astronomical observations in the radio spectrum comprehend as in the optical, the measurement of the intensity and polarization of radiation incident upon the earth, as a function of direction of arrival, frequency and time. While the intensity measurements reveal the brightness distribution in the sky and location of discrete sources, measurements of polarization provide means of investigating extraterrestrial magnetic fields. Most extraterrestrial radio waves are randomly polarized, but some are partially circularly or elliptically polarized. Circularly polarized radiation has so far been detected only in the Sun.

The basic equipment used in radio astronomical studies is the radiometer, more popularly known as radio-telescope; an optical counterpart, but with very much smaller resolving power, consisting in its simplest form, an aerial and receiver combination. With the notable exception of the study of the powerful radio emissions from the Sun, and of the recently discovered spectral line at 21 cm. from interstellar gas, most investigations in radio astronomy have been carried out in the wavelength region of 1-10 m. In this waveband there are three common methods by which directivity can be readily obtained; by the use of arrays of dipoles, by arrays of yagi-aerials or, by paraboloidal aerial systems. In each case, the basic unit is generally a centre fed half wave dipole, which has a natural resonant frequency corresponding to a wavelength of twice its length.

Aerial systems in common use are linearly polarized in the direction of their maximum acceptance. Polarization studies are made with either a crossed system of aerials or by rotating the linearly polarized aerial about the axis of propagation. Circular polarization can be analysed using two linear elements with their planes of polarization arranged mutually perpendicular and a quarter wavelength delay line introduced in one of them.

INTERFEROMETERS

The overriding limitation to astronomical investigation at radio wavelengths lies in the

poor resolving powers of practicable radio telescopes, comparable with its optical counterparts. For example, comparable resolutions at 1 m. wavelengths could be obtained with an aperture of 5 kilometres. Directional measurements of high precision have however been made possible by the use of interference methods, in which the relative phase of the incident radio wave-front is determined at two or more widely spaced points.

Two types of radio interferometers have been used. The first developed in Australia employs an aerial mounted on a high cliff overlooking the sea and makes use of the interference between the direct and reflected rays, as in Lloyds Mirror Interferometer. The second, developed in Cambridge, uses two aerials separated from each other by a large number of wavelengths and connected to the same receiver; the system being analogous to Michelson's stellar interferometer. In both systems, the rotation of the earth causes the source of radiation to pass through the interference fringes. This, however, is much too slow for recording short radio outbursts. In one method the lobe pattern of the interferometer is rapidly swept through the source, by mechanically varying the path length between one of the two aerials and the receiver. A second method of obtaining continuous records of position is to sweep the frequency instead of the phase.

The phase-switched aerial system devised by Ryle, and the artificial generation of pencil beam aerial introduced by Mills and Little are two important refinements in interferometer techniques. In the former, the background component of the radiation due to the galaxy is automatically balanced out, leaving only the weak signal due to discrete radio sources; this is achieved by connecting the two aerials of the interferometer, alternately in phase and out of phase, and measuring the output. The essential principle of the latter is that when two different aerials are combined, interference is possible for radiation from the region common to both beams.

PARABOLOIDAL SYSTEMS

Aerials of parabolic form have achieved popularity as radio-telescopes, because of their easier steerability. Further, they can be readily used over a range of wavelengths by merely changing the dipole system at the focus. They are characterised by high directivity and are not unduly large. The simplest of this type is the cylindrical paraboloid. Parabolical telescopes of a circular aperture are at present

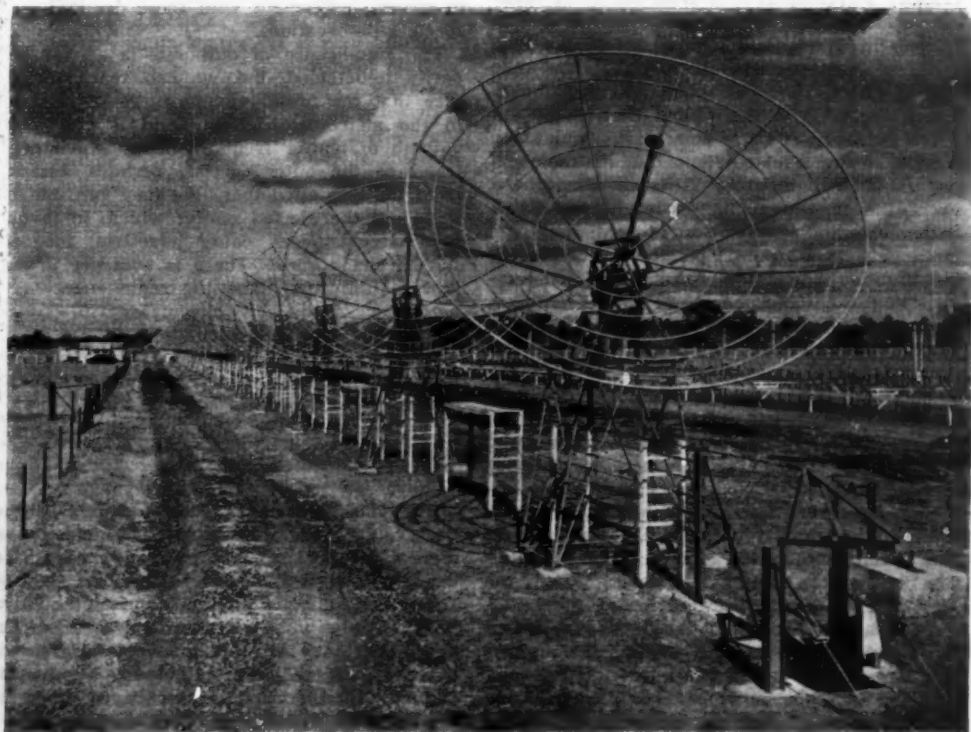
use, in many parts of the world. Notable amongst these are the 218 ft. paraboloid at Jodrell bank completed in 1946, 80 ft. paraboloid at Sydney and the 50 ft. paraboloid at the Naval Research Laboratory, U.S.A. At Cambridge University there is the steerable cylindrical paraboloid.

Construction of new radio-telescopes in Cambridge under the direction of Prof. M. Ryle and at Jodrell Bank under Prof. Lovell is nearing completion. The Cambridge Project has already been formally opened and will be known as Mullard Radio Astronomy Observatory, and function as part of the Cavendish Laboratory. The radio star interferometer designed for a wavelength of 1.7 m. employs a

built, one is intended for the study of radio stars (1.7 m.), and the other for the investigation of the continuous galactic radiation at a wavelength of 7.9 m. The former instrument employs cylindrical parabolas, while the latter is a pencil beam system.

The new giant radio-telescope that is nearing completion at Jodrell Bank, Manchester, is a completely steerable 250 ft. paraboloid supported on alti-azimuth mounting and is capable of automatically following a celestial source.

In Australia a new radio-telescope based on Mills cross principle designed by Dr. Christiansen has been completed, and this employs 64 parabolic dishes each 19 ft. in diameter and erected on an equatorial mount. Each arm of



The New Australian Radio Telescope designed by Dr. Christiansen
(Photograph by courtesy of the Australian High Commission, New Delhi)

new technique known as 'aperture synthesis' to produce what is effectively a 'pencil beam' system. With two elementary movable systems a large area of aperture is covered by taking measurements successively at all positions in two separated apertures, and a synthesis is made. Of the two instruments now being

the cross consists of 32 dishes, with 40 ft. space between them. The arms, each of which is 1,240 ft. long, intersect at right angles in the centre. It is claimed that it can focus on an area of less than 1% of the Sun's disc. This radio-telescope has been commissioned in July 1957, and is expected to make significant

measurements were crude, but, when radio telescopes of better resolution came in, positional radio astronomy developed to a high degree of accuracy. Optical identification of discrete sources have yielded highly fruitful results. When Baade and Minkowski of Mount Wilson and Palomar observatories photographed the regions of the Cygnus and Cassiopeia sources with the 200 inch telescope, some exciting results emerged. The Cygnus source proved to be a fantastic object; two distant galaxies in collision emitting approximately as much energy in the radio-spectrum as in the optical. The Cassiopeia source proved to be a mysterious and an unknown type of galactic nebula. The Crab Nebula, the remnant of a Supernova explosion, was found to be another certain radio source. It is now established that there are at least four distinct types of radio sources associated with: (1) Remnants of Supernovæ, (2) Galactic nebulosities of a new type, (3) Normal external galaxies, and (4) Peculiar external galaxies. It is interesting to note that all known sources are associated with nebulous objects.

Radiation has been detected from a number of relatively close and normal galaxies, including the great nebula in Andromeda. Most of these galaxies are spiral nebulae for which the radio magnitudes appear to be related to the optical magnitudes. Of individual external systems, the Magellanic clouds alone are close enough to allow investigation of internal detail with available resolving powers. This has been done in the continuous spectrum and with the 21 cm. hydrogen line. The distribution of visible extragalactic nebulae over the celestial sphere shows strong concentration along a band which very roughly follows part of the great circle region known as the "super-galaxy". A weak band of radio emission has been located in this position and is believed to be due to the 'super-galaxy'.

The discrete sources twinkle, especially at low altitudes and the scintillations have been traced to irregularities in the F_2 and E layer. The phenomenon allows the structure and apparent motion of the irregularities to be studied.

THE 21-CM. HYDROGEN EMISSION

During a colloquium on Jansky's and Reber's investigations organised by Nederlandse Astronomen Club in 1944, Van de Hulst suggested that interstellar hydrogen would emit a line at a wavelength of about 21 cm., with measurable intensity. The successful observation of this line at 1,420 Mc/s. (21.11 cm.) by Ewen and

Purcell in 1951 opened up a new astronomical vista, with previously undreamt of possibilities, for extending our knowledge of the universe. The observation was confirmed a few weeks later by Muller in Holland and by Christiansen and Hindman in Australia.

The 1,420 Mc/s. atomic hydrogen line is a hyperfine-structure line which is associated with a transition line between two sublevels of the ground-state. The electron spin can assume two possible orientations in the weak magnetic field associated with the nuclear magnetic moment, thus giving rise to two levels. This line has been observed in the laboratory using the magnetic resonance method. The natural line-width is exceedingly small, 5×10^{-16} cycles per second. The actual line-width under practical conditions is determined by other causes, of which Doppler broadening is of paramount importance. At this frequency, a velocity of 1 kilometre per second corresponds to a frequency shift of 4.73 Kc/s. The intensity of the line depends on the optical depth of the source and the relative populations of the two atomic levels concerned.

The equipments used to detect the 1,420 Mc/s. line were designed with the object of attaining high sensitivity, together with a narrow bandwidth of some tens of kilocycles per second. The narrow bandwidth is achieved by using a superheterodyne receiver with double frequency changing. The bandwidth of the first I.F. amplifier is made broad enough to avoid the necessity of tuning the R.F. circuits. The second oscillator and I.F. amplifier are used to select and sweep the narrow band channel. It is important to eliminate equipment instability, by the use of a comparison method. The receivers are therefore switched between two frequency bands of the order of 100 Kc/s. apart about 30 times per second. The difference between the outputs in the two bands was recorded. The two bands are tuned together and this will give rise to a positive peak when a narrow line coincided with the first band, followed by a negative peak as the second band coincided with the line.

A radical re-design of equipment appeared to be desirable, though very useful studies have been made with the one described above. The radiation is exceedingly weak and therefore a higher sensitivity is to be achieved for detection of much weaker intensities. Secondly, though the line profile of radiation from the galaxy extends over nearly a megacycle, it has useful details over a few tens of kilocycles. Consequently, it is desirable to use an extremely

narrow bandwidth in the detection channel, of a few kilocycles. Long integration times have to be used for attaining such a narrow bandwidth. An improved type of equipment is used in Sydney which evades the frequency scanning difficulty by employing a large number of narrow band output circuits simultaneously.

Very important results have emerged from the study of Doppler shifts and intensity maxima of the hydrogen line. The most important cause of line broadening effect is ascribed to the differential galactic rotation. The sign of the displacement on areas at varying distances from the galactic centre is observed to be as predicted. The appearance of strong maxima and minima indicate an irregular distribution of density or, of the velocities of the interstellar gas. It seems most likely that the maxima and minima are due to a patchy density distribution, and the regions of high density in the galactic plane of atomic hydrogen gas have the form of spiral arms, and the direction of rotation is with the arms trailing. Doppler shifts accompany random closed motions. Temperature and density measurements of interstellar regions are also possible from such studies. The density is very low and for the arm through the Sun, the provisional value of 0.9 atoms per cm.³ has been given.

The observation of spiral arms in the galactic system, first discovered over a relatively small region by W. W. Morgan and others in 1951 opens the door to three important domains of investigation. Since in the spiral arms, the gas represents about 20% of the total density, their influence on the general gravitational field of the galaxy is an interesting point to be inquired into. In the second place, it is interesting to explore which stars, besides the gas, are concentrated in the arms. Thirdly, one could go into the past history of the observed spiral arms.

The radio emission line of hydrogen does not end in the galactic system, and Australian observers have already announced that they have observed the 21-cm. line from both Magellanic clouds and that it has there an intensity comparable to that observed in the Milky Way regions. As regards the origin of cosmic radio waves, the clues so far obtained point to the following: Continuous cosmic radio emission has its origin in the violently agitated interstellar matter and is responsible for the mysterious intense components; the ionized hydrogen gives rise to continuous thermal radiation, and the main constituent, cold neutral hydrogen emits the 1,420 Mc/s. atomic line.

It is interesting to note that hydrogen is a major constituent of interstellar space. The 21-cm. emission line has extended our limit of vision far beyond into space wherefrom, the visible radiations are unable to reach us owing to the great distances and the opacity of interstellar dusts and clouds.

Powerful radio outbursts from the planet Jupiter were first observed by workers at the Carnegie Institution, Washington. The source seems to be associated with a white spot which has been confirmed by eclipses of the radio noise observed when one of the Jupiter's moons moved between the source and the earth. The puzzling problem is the origin of the radiation. It has also been found that the waves exhibit circular polarization as is the case with radiations emanating from regions associated with sunspot activities in the case of the Sun.

Radar reflections from the moon have been used to investigate the moon itself and the terrestrial ionosphere and radar observation of meteor trails are additional facets to radio astronomy.

Radio astronomy has established itself as a powerful tool and in the years to come is bound to advance our ideas of cosmology.

A. JAYARAMAN.

SOVIET UNION'S RADIO TELESCOPE

THAT a large radio telescope has been built in the Soviet Union has recently been announced at a Conference of Radio Astronomers in Moscow. The telescope is stated to be 130 metres long with a radio-reflector having a collecting area of 400 square metres. It is

claimed that the telescope is capable of receiving radio signals of centimetre wavelength.

It has also been claimed that another radio telescope is now being built which will employ a molecular amplifier and this will increase the radio telescope's range about 50-fold.

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INFRARED SPECTRA AND POLAR EFFECTS

C. N. RAMACHANDRA RAO AND GLADYS BLANCHE SILVERMAN

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THE characteristic vibration frequencies of groups in the infrared region are markedly influenced by the nature and the position of the substituents attached to them. In the ultraviolet absorption spectra of benzene derivatives it has been found that while the magnitude of the displacement of the primary band of benzene is determined by the resonance parameters of the substituents, the intensities depend on the over-all electronegativities, i.e., the combination of the resonance and inductive effects.^{1,2} The infrared group frequency shifts have been correlated with reactivities and other physical properties. A linear relation of the characteristic frequencies, ν , with the Hammett σ values of groups has been proposed by a number of workers. However, in a few cases there are considerable deviations from the linear plots. Thompson *et al.*³ have recently expressed doubt as to whether the roughly linear plots of ν against σ have much physical significance and have considered the possibility of plotting ν^2 versus σ . They propose that the slight curvature of the ν/σ plot might disappear in a ν^2/σ plot. We have now investigated the applicability of the reactivity constants developed by Brown and Okamoto⁴ for electrophilic reactions, σ^+ , and the resonance and inductive parameters derived by Taft,⁵ for the correlations of infrared group frequencies and intensities.

Brown σ^+ values differ from Hammett σ values by an extra resonance factor resulting from greater opportunity for resonance in electrophilic reactions. In fact, the resonance parameters derived from the σ^+ values are proportional to the resonance parameters from σ values. Fig. 1 shows the carbonyl frequencies in substituted benzophenones,⁶ acetophenones⁷ and benzoyl peroxides⁸ and the hydroxy group frequencies in substituted benzoic acids,⁹ plotted against the σ^+ values of the substituents. The plots are reasonably linear and in some cases the deviations from the linear plots seem to be less than in the Hammett σ plots. The deviations from the $\Delta\nu/\sigma^+$ linear plots are much lower, particularly in the case of substituted acetophenones, benzophenones, ethyl benzoates and benzoyl peroxides. In Table I are shown the approximate values of the slopes for the various group frequencies correlated by us. It is interesting to note that the positive slope for the carbonyl group frequencies is constant bet-

ween 11 and 12 in all cases except in benzoyl peroxides. The slopes for the hydroxy frequencies are negative.¹⁰ The correlation of the vibration group frequencies with σ^+ values of substituents seems to suggest a carbonium ion

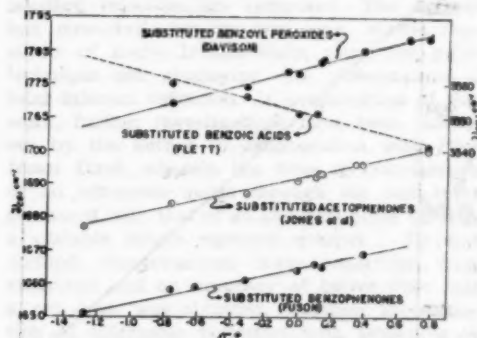


FIG. 1. Correlation of infrared group frequencies with the reactivity constants of Brown and Okamoto.

TABLE I
Approximate slopes of the various ν/σ^+ plots

Group Frequency	Compounds	Slope = $\frac{\Delta\nu}{\Delta\sigma^+}$
CO	.. Benzoyl peroxides ⁸	13.0
	Ethyl benzoates ⁸	11.6
	Benzaldehydes ⁸	11.0
	Benzophenones ⁸	11.0
	Benzoic acids (dimer) ⁹	11.6
	Acetophenones ⁷	11.0
OH	.. Phenols ¹⁰	-14.0
	Benzoic acids ⁹	-12.5
CN	.. Benzonitriles ¹¹	9.2

character of the excited state in the infrared, thus explaining the necessity of an extra resonance term in the substituent constants.

In the case of aliphatic compounds, the influence of the substituents on the group frequencies will be mainly through inductive effects. A plot of the hydroxy group vibrational frequencies in aliphatic carboxylic acids¹² against the aliphatic polar substituent constants of Taft⁵ is excellently linear (cf. Fig. 2).

The absorption band intensity of a group seems to be controlled by factors different from those determining the absorption frequency. Borrow¹³ has shown that in conjugated ketones the carbonyl band intensity varies with the

resonance energy of conjugation. Bellamy¹¹ seems to suggest that the intensity depends on the resonance effects of the substituents. However, Thompson *et al.*^{3,11} find a linear relation

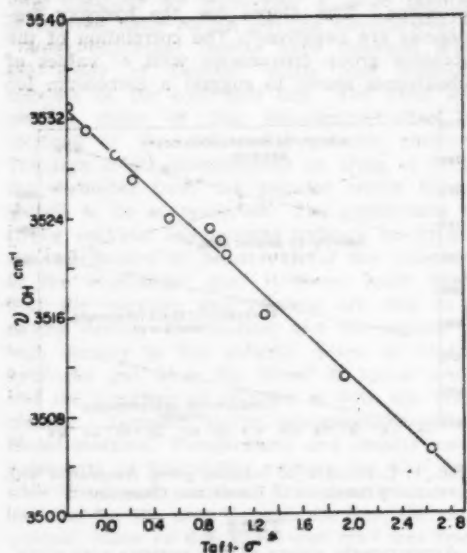


FIG. 2. Correlation of the hydroxy group vibrational frequencies of saturated carboxylic acids with Taft's aliphatic polar substituent constants.

between the logarithm of the intensity and Hammett σ . Jones *et al.*⁷ on the other hand are unable to quantitatively correlate the carbonyl band intensities in substituted acetophenones.

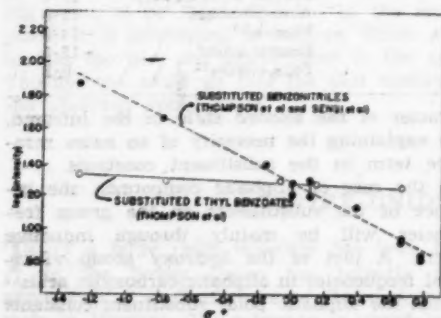


FIG. 3. Correlation of the absorption band intensities with the reactivity constants of Brown and Okamoto.

But their results are qualitatively consistent with Borrow's proposal.¹³ In aliphatic alcohols, Brown and Rogers¹⁵ find that the hydroxy group intensity varies with the inductive effects of the substituents. Fig. 3 shows plots of log (intensity) versus σ^+ values for the carbonyl group in ethyl benzoates³ and the nitrile group in benzonitriles.¹¹ No straightforward relation between the band intensities and Taft's resonance or inductive parameters⁶ was apparent.

The infrared group frequency shifts in aliphatic and aromatic derivatives provide an independent measure of the relative magnitudes of the inductive effects and the over-all electronegativities of the substituents. It appears that the absorption band intensity of a group is also a function of (though not the same as that of the absorption frequency) the over-all electronegativity. An analysis of the results indicates that the Brown σ^+ values can be used for the correlations of the infrared spectral frequency shifts and intensities, with as good an agreement as that obtained by using the Hammett σ values.¹⁶

The authors are thankful to Professor Herbert C. Brown, Department of Chemistry, Purdue University, for his kind interest.

1. Rao, C. N. R., *Curr. Sci.*, 1957, **26**, 276.
2. —, *Chem. and Ind.*, 1957, 1239.
3. — and Silverman, G. B., *J. Sci. Industr. Res.* (in Press).
4. Thompson, H. W., Needham, R. W. and Jameson, D., *Spectrochim. Acta*, 1957, **9**, 208.
5. Brown, H. C. and Okamoto, Y., *J. Am. Chem. Soc.*, 1957, **79**, 1913.
6. — (Unpublished Results).
7. Taft, R. W., in *Steric Effects in Organic Chemistry*, edited by M. S. Newman, John Wiley & Sons, Inc., New York, 1956, Chapter 13.
8. Fuson, N., Josien, M. L. and Shelton, E. M., *J. Am. Chem. Soc.*, 1954, **76**, 2526.
9. Jones, R. N., Forbes, W. F. and Mueller, W. A., *Canadian J. Chem.*, 1957, **35**, 504.
10. Davison, J., *J. Chem. Soc.*, 1951, 2456.
11. Flett, M. St. C., *Trans. Farad. Soc.*, 1948, **44**, 767.
12. Ingraham, L. L., Corse, J., Bailey, G. F. and Stitt, F., *J. Am. Chem. Soc.*, 1952, **74**, 2297.
13. Steel, G. and Thompson, H. W., *Trans. Farad. Soc.*, 1956, **52**, 1451.
14. Goulden, J. D. S., *Spectrochim. Acta*, 1954, **6**, 129.
15. Borrow, G. M., *J. Chem. Phys.*, 1953, **21**, 2006.
16. Bellamy, L. J., *J. Chem. Soc.*, 1955, 4221.
17. Brown, T. L. and Rogers, M. T., *J. Am. Chem. Soc.*, 1957, **79**, 578.
18. Okamoto, Y. and Brown, H. C., *J. Org. Chem.*, 1957, **22**, 485.

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ELASTIC BEHAVIOUR OF ROCKS

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1. INTRODUCTION

THE interpretation of the observed elastic wave velocities in rocks of the earth's crust is our principal basis for inferring its structure at inaccessible depths. Such interpretation requires a knowledge of elastic moduli in respect of typical rocks when subjected to high temperatures and pressures. From this point of view, a determination of elastic wave velocities in rocks *in situ* seems to be more or less an urgent problem, but this is beset with many practical difficulties and two factors complicate the laboratory measurements. Firstly, ordinary rock is generally a complex mixture of different crystals and has a low tensile strength. Secondly, in the laboratory under atmospheric pressure, the rock is released from the confining pressure, and the internal condition may be different from normal. Even fresh rocks experience changes of pressure, temperature, or both, which, acting unequally upon the different kinds of crystals, loosen the structure. Preparation of rock samples for the laboratory study, will produce further deterioration. However, during recent years, high frequency methods where the structure of the rock plays a less prominent part have been developed. Ultrasonic pulse techniques developed in several geophysical laboratories are of this category and the methods have enabled accurate measurement of elastic wave velocities in rocks, at high pressures and temperatures, corresponding to great depths of the earth's crust. Rocks which are in the nature of polycrystalline aggregates with the crystallites in random orientation, will be elastically isotropic, exhibiting only two elastic constants.

2. EXPERIMENTAL TECHNIQUES

Many static and dynamic methods have been developed since 1924 to measure the elastic constants of rocks. The presence of minute cracks, large-scale structural features which are inherent in the rock, and the looseness of packing affect the static measurements which involve bending, twisting and such other processes and the results obtained are therefore often unreliable. Dynamic methods and specially the high frequency methods are less sensitive to the presence of fine cracks in a specimen and textural features such as pore spaces and other large-scale textural features in a bigger sample. Among the ultrasonic methods, optical diffraction techniques (e.g., Wedge

method) and the pulse technique have been successfully employed to determine the elastic constants of rocks. Hughes and collaborators¹ have measured the travel times for both longitudinal and torsional waves over a given length of the specimen. From such data, the corresponding velocities are computed. The author² has measured, for the first time, elastic constants of many Indian rocks using the pulse technique and employing the phenomenon of total internal reflection. In continuation of this work, further investigations have been carried out by the author in collaboration with Professor Birch wherein the time of transmission of an ultrasonic pulse through the sample is compared with that of an identical pulse through a variable length mercury column. By this method, compressional wave velocities were measured and an accuracy of better than half a per cent. was obtained. Further, the variation of ultrasonic velocities with pressures of the order of 10,000 bars corresponding to a depth of 35 km. (Mohorovicic discontinuity) has been investigated and several interesting conclusions have been drawn.

3. SOME SIGNIFICANT RESULTS

A critical review of the results reported so far suggests that rocks show a wide variation in their elastic behaviour. Longitudinal velocities in rocks lie between 5,500 and 7,200 m./sec. and torsional velocities between 2,600 and 3,600 m./sec. The values in the case of igneous rocks are usually higher than those in sedimentary and metamorphic rocks. The Poisson's ratio is usually between 0.250 and 0.400. Bruckshaw and Mahanta³ studied the variation of the elastic constants of rocks with frequency. Their results show a slow increase of the elastic constant (Young's modulus) with frequency over the range 40-120 cPs, the increase ranging from 2.1% upto 2.6%. It is to be noted that this effect, in the less compact sedimentary rocks is somewhat greater than for others. Marked variation in elastic wave velocities from rock to rock within the same type is a noteworthy feature. One of the reasons for the discrepancy might be the different techniques employed by the several workers to determine the elastic constants of rocks. This can be got over, if one experiments on the same sample using several different methods. It appears that fruitful results may be thus obtained. It should also be examined if the formulæ

connecting various constants, applicable to crystals and other homogeneous solids, can as well be applied to the more heterogeneous bodies like rocks.

Variation of velocities in rocks within a temperature range of 600° C. and a pressure range of 10,000 bars has been investigated⁴ systematically. Velocities decrease rapidly with temperature at a given pressure and increase with pressure at a given temperature. It is, however, observed that results are repeatable, only within a range of 150° C. and beyond that the rock disintegrates and cracks are developed and hysteresis sets in. The velocities in rocks increase very rapidly with pressure, specially at low pressures and becomes more or less steady at 6,000 bars. In the low pressure region, the rise is essentially a function of porosity. The results are not readily repeatable in these cases. Shimozuru⁵ working on the elasticity of marbles suggests that at low pressure, the dilatational velocity increases with pressure at a considerable rate, until it ceases to increase and begins to decrease slightly with pressure. The velocity increase in the low pressure region may be due partly to the finite compression of the specimen and partly to the vanishing of void spaces due to pressure. It was further found that the velocity decrease of dilatational waves starting from a point far below the fracture stress could be regarded as symptoms of fracture. He concludes, as a result of many measurements, that a rock which has a large initial value of Young's modulus shows little change of that parameter and therefore of longitudinal velocity with stress. Thus, it appears that theoretical and experimental values agree pretty well when the pressure is above 2,000 bars. Above 2,000 bars pore spaces seem to vanish completely in a rock and the compression of the minerals themselves constituting the rock sets in.

Hughes and McQueen⁶ studied the density of basic rocks at very high pressures. The density of two gabbros and one dunite have been measured at several pressures in the range from 150 to 750 kilobars. These pressures were attained in shock fronts generated by high explosives. The densities were computed from the observed shock waves. The dunite with an initial density of 3.25 g./c.c. was compressed to a density of about 4.9 g./c.c. at 720 kilobars. The gabbros, with initial density of 3.0 g./c.c., were compressed to 5.0 g./c.c. at 750 kilobars. Both the gabbros showed evidence of a polymorphic transition at pressures around 150 kilobars to a more dense, but less compressible phase.

That rocks are elastically almost isotropic has been established beyond doubt. Slight departures from perfect isotropy in isolated cases may be attributed to the heterogeneous nature of the rocks and to the preferential orientation of mineral grains. It was observed that the percentage anisotropy, if any, is of the same order for the longitudinal and torsional velocities. However, it should be remarked that in bedded and stratified rocks the velocities in two directions, namely, perpendicular to the bedding plane and in the bedding plane, differ appreciably.

In monomineralic rocks, it is observed that in coarse-grained ones, the velocities are low and the absorption is high and in fine-grained ones the velocities are high and absorption low. Study of absorption of sound in rocks involves measurement of intensity when a variable distance in the medium is traversed by the sound beam. Attenuation in the case of rocks has been measured by the author at three frequencies in the range of 2 to 10 mc./sec. Results show that the absorption increases rapidly with increasing frequency. It is to be expected that investigations on attenuation in marbles will throw some light on the dependence of attenuation on particle size—a verification of Rayleigh scattering phenomena—as they are best suited for such a study. It is interesting to note that in limestone which is fine-grained, homogeneous and closely compacted, the variation of attenuation is slight but linear with frequency. This is probably due to the absence of scattering. However, with a limestone heated to 400° C. and cooled it has not been possible even to transmit a pulse through it. It was found in this case that the colour of the specimen had changed and number of cracks were also observable.

4. SPECIAL FEATURES OF INDIAN ROCKS

Results on Indian granites deserve special mention. Velocities in these granites seem to be very high when compared with those of American origin. Indian granites show high velocity values at low pressures and consequently only a little rise in velocities at high pressures (10,000 bars). This can be attributed to two factors: firstly, to the low porosity and high compactness of Indian granites, and, secondly, to the older age of Indian granites when compared to the relatively young American granites. It is also likely that Indian granites were consolidated at great depths and later uplifted, a process which will have considerable effect. Thus, depth of overburden and porosity seem to control the velocity. Results

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on Deccan traps are interesting. Rocks taken from different flows show different values. Systematic investigation of the Deccan trap rocks may throw some light on the effect of environmental conditions existed during their formation, on the velocity. Unusually high longitudinal velocity of the order of 7,000 m./sec. in Manditog marbles is of interest. Study of deformation of marbles and other rocks will throw some light on the strength of rocks. Measurement of longitudinal velocities in rocks under simple compression, in directions parallel and perpendicular to the direction of compression upto rupture point will give us some

evidence for rock deformation. Such studies are likely to suggest possible explanations of the mechanism of rock bursts.

1. Hughes, D. S. and Maurette, C., *Geophy.*, 1957, 22, 1.
2. Balakrishna, S., *Physical Properties of Rocks and Their Relation to Geological Features*, Thesis submitted to the Osmania University, 1955.
3. Bruckshaw, J. McG and Mahanta, P. C., *Petroleum*, Leonard Hill Ltd., London, January 1954.
4. Birch, F., *Geo. Soc. Am. Bull.*, 1943, 54, 266.
5. Shimozura, D., *Bull. Earth Res. Inst.*, 1952, 30, 63.
6. Hughes, D. S. and McQueen, R. G., Personal Communication, 1957.

ROTHAMSTED EXPERIMENTAL STATION—1956

THE Rothamsted Experimental Station is devoted to agricultural research. It is the oldest institution that has been continuously engaged for 113 years in search of the basic principles underlying crop growth and improvement, and has contributed in no small measure to the evolution of British agriculture and has been a source of inspiration and guidance to workers outside Britain.

Agriculture makes contact at various points with a number of widely differing branches of science. The scientific work of the Station is organised in thirteen departments—Physics, Chemistry, Pedology (Soil Science), Soil Microbiology, Botany, Biochemistry, Plant Pathology, Nematology, Insecticides and Fungicides, Entomology, Statistics and Field Experiments. To supplement and enlarge laboratory work in the field, there are two experimental farms—one at Rothamsted on heavy soil and the other at the ancillary station at Woburn on light soil.

The report is a record of the work of the several departments during the year 1956. All are interesting and informative. Much of the work is the continuation of that commenced in the previous years. In the space of a short review, it is impossible to do justice to the work of each of the several departments or even to that of one department. From a reading of the report with those of the earlier years the reader recognises old facts and problems in new settings and learns new ones. Attention will be paid to a discussion of one or two of them.

The Rothamsted Station had its origin in the controversy on plant nutrition between the German chemist Liebig and the British squire Lawes, and the chemist Gilbert. In the year 1840, Liebig made an analysis and synthesis of

the then available facts and ideas and propounded his mineral theory of plant nutrition. According to this theory, plants could obtain from the atmosphere, all the carbon and nitrogen required for their growth and development and all that was required was to apply phosphates after making an analysis of the soil for its phosphate content. Lawes and Gilbert, while appreciating the great implication of the problem of soil fertility, doubted the ability of plants to obtain their nitrogen from the atmosphere. They set about experimenting in the laboratory and in the field and provided evidence that plants required supply of combined nitrogen in the form of nitrates. Thus began in the year 1843, the Rothamsted Station and its experimental work.

Experience over a century at Rothamsted and outside, has shown Liebig as well as Lawes and Gilbert to be both right and wrong. Certain plants under certain circumstances are capable of utilising atmospheric nitrogen for their growth and development, provided the phosphate need is met; while certain other types of plants are unable to utilise atmospheric nitrogen and require supplies of combined nitrogen. As stated elsewhere, an year or two ago, by the Director of the Rothamsted Station, the high hopes entertained, that a chemical analysis of the soil would provide the farmers with precise information regarding their soils and manuring their crops, have not been realised and that today, with his present knowledge, the chemist can do little to keep the farmer in deciding the exact amounts he should apply on the basis of chemical analysis of the soil.

This is so, particularly in respect of soil nitrogen and more particularly in India, where climatic, physical and biological factors are involved and the reactions and interactions

proceed faster than in the temperate climate of Rothamsted. In their investigations on nitrogen fertilisers described in the report, the Rothamsted workers mention losses of nitrogen by denitrification.

The most important consideration from the scientific and practical aspects of soil fertility is that concerned with the input and output of the nitrogen in the soil, which is a major plant nutrient taken from the soil. Soil micro-organisms have long been known to fix atmospheric nitrogen, to produce nitrates and to bring about loss of nitrogen either as gas by denitrification or by the leaching of nitrates through the soil and thus bring about what is called nitrogen-cycle. This view is universally accepted. Evidence has been growing in recent years in support of the view of Indian workers that besides micro-organisms, purely physico-chemical factors also contribute to the processes of the nitrogen cycle in the soil under natural conditions. This view is not universally accepted. Whatever may be the nature of the process, there is unanimity in the view that nitrogen fixation occurs in the soil, that inorganic and organic nitrogenous substances in the soil are converted into nitrates (the form in which plants take up nitrogen) and that loss of nitrate nitrogen occurs either by leaching or by denitrification or by both.

If nitrate is a plant nutrient, what is the significance of the provision in the soil for the readily occurring loss of nitrogen in different ways? What is the relationship, if any, between nitrogen fixation and nitrogen loss with nitrification in between? We do not know. If part of the added nitrogen is lost and part is taken up by plants, how can a mere soil analysis be depended upon, as the basis for determining fertiliser schedules for the soil? We do not know. When the premises themselves are in doubt, the appeal to statistical analysis and significance in support of correlation between soil analysis and crop response will end in providing undue accuracy for empiricism and unwarranted assumptions.

In the departments of physics, pedology and chemistry, new ideas and techniques have been applied in recent years, to studies on the soil *per se* and as the medium for crop growth, designed for more and better understanding of an agricultural soil. Attention continues to be given to studies on soil genesis, soil profiles and horizons and to the study of soil clays, their minerals, and soil organic matter. A great deal of information has been obtained in these directions, but comparatively little of it has yet

found application in agricultural practice. The conception of an agricultural soil continues to be made to accommodate itself to the facts that it has to explain. We are still very far from a precise conception of the soil based on studies with soil isolated and purified.

A few years ago, workers in India attempted to reduce the soil to its basic silicate stage by chemical methods and to interpret the colour and other physico-chemical properties by simulating the soil with superimposed treatments. The work appeared to be promising but there have been no further reports. The Rothamsted workers report attempts at a synthesis of clay minerals from silica-alumina gels. Using pressures and temperatures above 300 atmospheres and 300° C., they have obtained a product answering to the tests for kaolins and halloysites. Attempts to prepare these minerals at temperatures closer to those found in soil are not so far successful. Recent Russian work shows that secondary minerals such as calcite, arragonite, chalcedony and even bidellite are formed in the soil from the chemical elements liberated by the breakdown of plant remains. This finds some support from another line of work at Rothamsted. The workers there have found that extracts of leaves of a number of plant species can reduce and mobilise iron compounds in a soil—a process attributed to the combined action of relatively simple aliphatic acids and reducing phenolic compounds in the leaves of the plants.

These and other observations of an isolated nature over some years are promising. Their immediate value lies in indicating that profile formation and horizon structure and composition in agricultural soils is not a one-way process from surface downwards, as was supposed from an examination of virgin soils, and that in cultivated soils the reactions in the so-called heterogeneous mixture of organic and mineral matter build up new compounds and minerals. The discussion at the International Congress in 1956 is a warning against the temptation to correlate soils purely on their morphological basis without first ascertaining that all morphological characters are identical and that the environmental histories are similar.

It may reasonably be expected that the preliminary stages of studies in the science of soil and soil science will soon come to a close and that attention will be directed from generalisations to studies of details for a more useful fundamental knowledge of agricultural soil.

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OBSERVATIONS ON THE SPAWNING IN INDIAN CARPS BY HORMONE INJECTION

H. CHAUDHURI AND K. H. ALIKUNHI

Central Inland Fisheries Research Substation, Cuttack

A DEPENDABLE source of quality fish seed is a fundamental prerequisite for large-scale development of fish culture. The problem of supply of fish seed to fish farmers has assumed great importance in India in recent years. The cultivated species of Indian carps are riverine fishes which normally breed in rivers during the monsoon months, from June to August. They do not normally breed in ponds. Fish seed, required for cultivation in ponds, consist of the eggs and hatchlings (spawn) and young fry which drift along the current of the water in rivers during flood period, and are collected from certain regions where they are found in concentrations. The extent of the breeding of carps in rivers depends on the fluctuations in the monsoon floods. Further, the breeding period of the fish is relatively short and as seed collection centres are very often situated in practically inaccessible and out of the way places, appreciable difficulty is often experienced in collecting the required quantity of fish seed. Besides, the fish seed collected from the riverine habitats are invariably a mixture of cultivable and non-cultivable species of fishes, often the proportion of non-cultivable or uneconomic species ranging high in the collections. In the absence of any dependable method to segregate the cultivable fishes from the non-cultivable ones at the early stage at which they are collected, the fish farmers have no choice but to rear them to an identifiable size when they could be separated. Thus the fish farmer has to take considerable chance in regard to procurement of fish seed. The rearing of appreciable number of unwanted fish involves wastage of valuable nursery space and expenditure.

The need to induce major Indian carps to breed in confined waters and thereby ensure a dependable source of quality fish seed has been greatly felt in India. Injection of fish pituitary gland hormones as a method of inducing breeding in fishes is known from early thirties in Brazil (Cardoso, 1934; von Ihering, 1937; Pereira and Cardoso, 1934). In recent years several workers in the United States and Japan have successfully induced breeding in certain species of fishes (Hasler et al., 1939, 1940; Ball and Bacon, 1954; Kawajiri et al., 1946). In India the first attempt in this work was

made by Hamid Khan (1938) who tried to induce spawning in *C. mrigala* by injection of the anterior lobe of mammalian pituitary gland. Although ovulation took place, the injected fishes did not spawn and the stripped eggs could not be fertilised. Recently, Ramaswamy and Sundararaj (1956 and 1957), have reported successful breeding of the catfishes *Heteropneustes fossilis* and *Clarias batrachus* induced by hormone injections.

The study of the effect of fish pituitary glands on the spawning in Indian carps and other fresh-water fishes was started at this Research Station in the year 1955 by one of us (Chaudhuri) who succeeded in inducing spawning of the carp minnow *Eomus danricus* and the riverine catfish *Pseudotropius atherinoides* by intraperitoneal injection of distilled-water suspensions of pituitary glands taken from ripe specimens of *Catla catla* and *Cirrhina reba* respectively. The first riverine fish to be induced to breed by hormone treatment in India is *Pseudotropius atherinoides*. An account of these experiments will be published elsewhere.

Although success was achieved to induce some of the minor species of fishes to breed by hormone treatment, it was only during the fish breeding season of 1957 that the major carps which are extensively used for cultivation in inland waters, were successfully induced to spawn by hormone treatment. Elaborate arrangements had been made to carry out these experiments at Angul and at Cuttack in Orissa. Carp breeders were collected and stocked in selected ponds and were thereafter regularly fed with oilcake so as to keep them in good condition and facilitate better ripening of the gonads. Just before the onset of regular monsoon, but soon after the early showers, the breeders were netted and the sexually ripe ones were segregated sexwise and transferred to separate ponds. Artificial feeding was continued even after separating the males and females.

Pituitary glands from mature carps were collected during May-June and were processed and preserved in absolute alcohol and kept under low temperature in a refrigerator. From the second week of July when regular monsoon set in, experiments were started. The breeders were netted and fully ripe males and

females were given injections and transferred to smaller ponds, cement cisterns, large fish fry carriers, glass aquaria and specially fixed hapas. Both intraperitoneal and intramuscular injections were tried. The hormone treatment was successful in breeding the major carps, Rohu (*Labeo rohita*), Mrigal (*Cirrhina mrigala*) and Calbasu (*Labeo calbasu*) and the medium-size carps, *Cirrhina reba*, *Labeo bata* and *Barbus sarana*. The experiment was partially successful in the case of Catla (*Catla catla*). While there was profuse ovulation in Catla, the eggs could not be fertilised as a ripe male of the fish was not readily available at the time. Injected fishes spawned in clear tap-water, accumulated rain-water and also in stagnant pond-water. With intraperitoneal as well as intramuscular injections some of the fishes spawned 6-8 hours after a single injection. Others required a second injection to induce successful spawning; while in several specimens even repeated injections did not induce spawning. Cool, rainy days appeared to be conducive to spawning and injected fishes generally did not spawn on hot, sunny days.

While fish pituitary glands alone were used in these experiments, there does not appear to be any marked specificity in regard to the effect on injected fishes (Chaudhuri, 1956). There was successful spawning of the catfish *Pseudotropius atherinoides* when injected with carp (*Cirrhina reba*) pituitary gland. In the present series of experiments Rohu gland was found to induce successful spawning not only in *Labeo rohita* but also in *L. bata*, *L. calbasu*, *Cirrhina reba* and *Barbus sarana*. Catla pituitary gland was similarly successful with *Cirrhina reba*, *Barbus sarana* and *C. mrigala*.

The dose of injection required to induce successful spawning appears to depend on the size of the breeder. When injected intramuscularly, a much less dose of the gland was sufficient to induce spawning than when the injection was given intraperitoneally. Specimens of *L. bata* and *L. calbasu* weighing 6 to 8 oz. required an injection of 0.5 Rohu gland for successful spawning under the latter method; while comparable size specimens of *Cirrhina reba* and *Barbus sarana* required only 0.04 to

0.08 Catla gland when intramuscular injections were given. Similar differences were seen in the case of Rohu also. There was heavy spawning in a few cases while in others it was only partial. In most cases of successful spawning, the majority of eggs were fertilized and the hatching rate was sometimes as high as 95%. The development proceeded quite normally, depending on prevailing water temperature. The developing eggs were kept in hapas for hatching, and hatchlings were stocked in nursery ponds on the fourth-fifth day when the yolk was fully absorbed. The growth of fry in the nursery ponds was also observed to be normal. The details of these experiments will be published elsewhere.

The results obtained during the 1957 carp breeding season have clearly demonstrated that the Indian carps could be successfully induced to breed by injection of pituitary gland hormones and that considerable number of fry could be raised by this method. To exploit this method economically, a large number of experiments have yet to be carried out and the number, frequency and dose of injections required for fishes of different sizes and species have to be standardized. Concerted efforts are now being directed towards this objective.

We are thankful to Dr. B. S. Bhimachar, Chief Research Officer, and to Shri G. N. Mitra, Director of Fisheries, Orissa, for their valuable suggestions and facilities in conducting these experiments.

1. Cardoso, D. M., *Arch. Inst. Biol.* (Sao Paulo), 1934, 5, 133-36.
2. Pereira, J. and Cardoso, D. M., *Compt. Rend. Soc. Biol.*, 1934, 116 (11), 1133-34.
3. von Ihering, *Prog. Fish. Cult.*, 1937, 34, 15-16.
4. Hasler *et al.*, *Endocrinology*, 1939, 25 (6), 978-83.
5. —, *Copeia*, 1940 (1), 43-46.
6. Ball, R. C. and Bacon, E. H., *Prog. Fish. Cult.*, 1954, 16 (3), 108-14.
7. Kawajiri, M., *et al.*, *Contr. Central Fish Sta., Japan*, 1946, 13-16.
8. Khan, H., *Curr. Sci., Bangalore*, 1938, 7 (5), 233-34.
9. Ramaswamy, L. S. and Sundararaj, B. I., *Science*, 1956, 123 (3207), 1080.
10. —, *Naturwiss.*, 1957, 44, 46.
11. Chaudhuri, H., *Ala. Pol. Inst. Bull.*, 1956.

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OBSERVATIONS ON THE DEPRESSANT ACTION OF RAUVOLFIA ALKALOIDS
ON THE TISSUE RESPIRATION IN RATS

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THE hypotensive and sedative properties of *Rauvolfia serpentina* alkaloids have been found to be of considerable clinical value in recent years. Siddiqui and Siddiqui, 1931, 1932, 1935, isolated and characterised 5 important alkaloids from the plant. Pharmacological actions of these were studied by Chopra and Mukherjee (1933), Chopra, Bose et al. (1942, 1943), Chopra and Chakravarty (1941), Gupta and Kahali (1947).

Since the work of Vakil (1949) on the clinical value of this plant in essential hypertension, considerable interest was aroused amongst workers of foreign countries for carrying out further investigations on this medicinal plant, growing in India. Mueller and Schlittler (1952) reported on the isolation of a hitherto undetected alkaloid from the Oleo-resin fraction of the crude drug and Bein (1953) worked out the pharmacology of this new alkaloid, known as Reserpine, in detail. The pharmacological actions of various alkaloids of *Rauvolfia serpentina*, as investigated by previous workers, have been exhaustively reviewed by Bein (1956).

An examination of available literature indicates that although considerable amount of chemical and pharmacological work has been carried out with the isolated active principles, the nature of *Rauvolfia* actions still remains complex and very little work, with the exception of that of Rau (1955), on the tissue respiration in brain slices, have been carried out with a view to elicit the mechanism of *Rauvolfia* depressant actions on various systems.

As the active principles of this plant possess important hypotensive and sedative properties, it was considered necessary to explore the action of 3 important alkaloids of the plant, namely, Reserpine, Serpentine and Ajmaline on the oxygen consumption of brain, liver and heart tissues by Warburg technique.

MATERIAL AND METHOD

Pure samples of alkaloids were obtained through the courtesy of Dr. Schlittler, M/s. Ciba & Co., New Jersey. The effect on the oxygen consumption was investigated on slices of brain, liver and heart tissues of rats, weighing between 120 to 150 g. and incubated with the different doses of Reserpine, Serpentine and Ajmaline in a Warburg apparatus as detailed in our previous communication (Bose et al., 1957).

RESULTS

The experimental findings with the three alkaloids of *R. serpentina* on the tissue respiration in rats are shown in Tables I, II and III.

TABLE I

Showing effect of Reserpine on the tissue respiration of brain, liver and heart of rats. The figures are the averages of four sets of readings in each case

Dose mg.	Brain QO ₂ /Ml/O ₂	Inhibition %	Liver QO ₂ /Ml/O ₂	Inhibition %	Heart QO ₂ /Ml/O ₂	Inhibition %
Control	7.20	..	5.00	..	4.40	..
0.10	6.42	10.8	4.80	4.0	3.80	13.6
0.25	4.14	42.5	4.60	8.0	3.10	25.0
0.50	3.30	54.1	4.24	15.2	2.41	45.2
1.00	2.19	69.5	3.00	40.0	1.86	57.5
2.00	0.43	94.0	2.80	44.0	1.41	68.0

From Table I it is evident that Reserpine produces a marked depressant action on the oxygen consumption of brain, liver and heart tissues, there being a gradual inhibition of respiration with increasing doses in each case. With a dose of 0.1 mg. of Reserpine, brain respiration is reduced by 10.8%. It increases to 94% with a dose of 2 mg. as against 44 and 68% inhibition of liver and heart respectively in equivalent concentration.

TABLE II

Showing the effect of Serpentine on the tissue respiration of brain, liver and heart of rat. The figures are the averages of four sets of readings in each case

Dose mg.	Brain QO ₂ /Ml/O ₂	Inhibition %	Liver QO ₂ /Ml/O ₂	Inhibition %	Heart QO ₂ /Ml/O ₂	Inhibition %
Control	6.60	..	4.80	..	4.00	..
0.10	6.50	1.51	4.60	4.10	4.00	..
0.25	6.00	9.13	4.60	4.10	3.80	5.00
0.50	4.80	27.20	4.00	16.60	3.40	15.00
1.00	3.31	50.00	3.43	28.60	3.11	22.20
2.00	2.90	56.10	2.47	52.70	1.93	51.70
4.00	2.80	57.50	2.08	56.60	1.39	65.25
6.00	2.41	63.60	1.94	60.00	1.11	72.50

From an examination of Table II, it will be seen that Serpentine also has got a depressant

action on tissue respiration of rat brain, liver and heart. The effect however is quantitatively less than in the case of Reserpine. In a dose of 0.1 mg., there is insignificant action on the oxygen consumption of the three tissues under investigation. With a dose of 1 or 2 mg. the inhibition reaches to 50%, 28% and 22% respectively. Even with a dose of 6 mg. the percentage of inhibition is only increased to 63.6, 60.0 and 72.5 respectively.

TABLE III

Showing effect of Ajmaline on the tissue respiration of brain, liver and heart of rats. The figures are the averages of four sets of readings

in each case

Dose mg.	Brain $\text{O}_2/\text{ML}/\text{O}_2$	Response %	Liver $\text{O}_2/\text{ML}/\text{O}_2$	Response %	Heart $\text{O}_2/\text{ML}/\text{O}_2$	Response %
Control	7.0	..	5.2	..	4.0	..
0.10	7.5	7.1+	5.7	9.6+	4.2	5.0+
0.25	8.0	14.3+	6.1	17.2+	4.8	20.0+
0.50	8.1	15.7+	6.6	27.0+	5.7	42.5+
1.00	6.8	2.8-	5.3	19.6-	3.7	7.5-
2.00	5.3	24.3-	2.88	44.6-	1.74	56.5-
4.00	4.3	35.7-	1.67	68.2-	1.49	62.7-
6.00	2.14	69.4-	0.88	83.1-	1.14	71.5-

An analysis of the above observation shows that unlike Reserpine and Serpentine, the effect of Ajmaline on the oxygen consumption of the three tissues under investigation, is of a different nature. In smaller concentrations, viz., 0.1 to 0.5 mg., there is an increase in the oxygen consumption, the maximum not exceeding 15.7% in brain, 27.0% in liver and 42.5% in the case of the heart tissue. With higher doses, viz., 1 to 6 mg., there is on the contrary an appreciable reduction in the tissue respiration, 69.4% in the case of the brain, 83.1% in the case of the liver and 71.5% in the case of the heart.

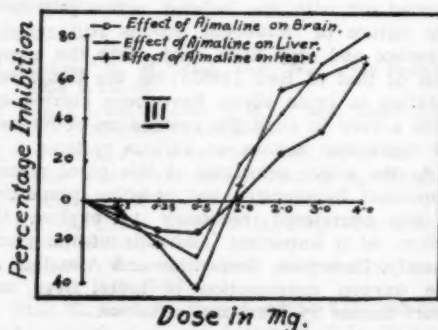
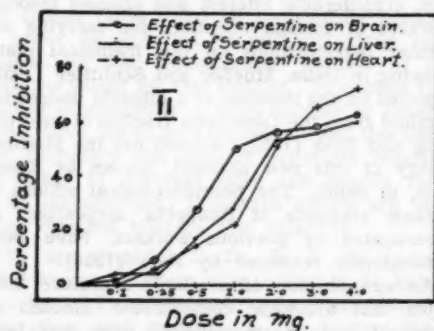
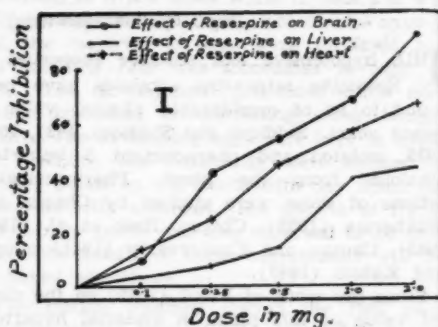
The results are graphically represented in Figs. 1, 2 and 3.

DISCUSSION

Of the three alkaloids investigated, Reserpine appeared to possess the maximum depressant effect on the oxygen uptake of brain and heart tissues. Serpentine also produced similar action but the degree of response was somewhat less in equivalent dose levels (2 mg.).

So far as Ajmaline is concerned, in smaller doses it was found to stimulate brain, liver and heart tissue respiration, the maximum effect being observed in heart tissue. With higher

doses, it produced an inhibitory action, the maximum depressant effect being in the case of liver tissue respiration.



From the above observations it is evident that Reserpine which is considered to be the most potent hypotensive and sedative principle of *R. serpentina*, is also the most potent inhibitor of brain tissue respiration, which might subscribe to its sedative property. The bradycardia caused by the alkaloid might also be due to diminished oxygen uptake of the cardiac tissue. The stimulation of tissue respiration by Ajmaline in smaller doses may be responsible for its convulsant property as observed by Chopra,

Bose et al. (1943) and its hypotensive effect in higher doses, reported by the same authors (*loc. cit.*), might be due to its depressant effect on the tissue respiration of heart muscle. The inhibition of tissue respiration by all the three alkaloids as observed in the present investigation might indicate a direct inhibitory action on the cellular metabolism affecting the respiratory dehydrogenase enzyme system.

Further work, that is being carried out from this laboratory on the effect of these alkaloids on dehydrogenase enzymes (unpublished paper), is in agreement with the above hypothesis inasmuch as Reserpine has been found to produce a marked inhibition of succinic dehydrogenase activity in these tissues.

Our thanks are due to M/s. Ciba & Co., New Jersey, for supplying the requisite alkaloids in pure form for the present work.

1. Bein, H. J., *Experientia*, 1953, 9, 107.
2. —, *Pharmacological Reviews*, 1956, 8, 435-83.

3. Bose, B. C., Gupta, S. S., Bhatnagar, J. N. and Vijayvargiya, R., *Ind. J. Med. Sc.*, 1957 (under publication).
4. Chopra, R. N., Gupta, J. C. and Mukherjee, B., *Indian Jour. Med. Res.*, 1933, 21, 261-71.
5. —, Bose, B. C., Gupta, J. C. and Chopra, I. C., *Ibid.*, 1942, 30, 319-24.
6. —, Gupta, J. C., Bose, B. C. and Chopra, I. C., *Ibid.*, 1943, 31, 71-74.
7. —, and Chakravarti, M., *Ibid.*, 1941, 29, 763-68.
8. Gupta, J. C., Ghosh, S., Datta, A. T. and Kahali, B. S., *J. Amer. Phar. Ass.*, 1947, 36, 416.
9. Mueller, J. M., Schlittler, E. and Bein, H. J., *Experientia*, 1952, 8, 338.
10. Rau, G. C., Eesenbrandt, L. L., Paradise, R. R. and Auyong, T. K. H., *Fed. Proc.*, 1955, 14, 381-82.
11. Siddiqui, S. and Siddiqui, R. H., *J. Indian Chem. Soc.*, 1931, 8, 667-80.
12. —, *Ibid.*, 1932, 9, 539-44.
13. —, *Ibid.*, 1935, 12, 37-47.
14. Vakil, R. J., *Brit. Heart J.*, 1940, 2, 350-55.

OBITUARY

PROFESSOR C. G. ROSSBY

PROFESSOR CARL GUSTAF ROSSBY died suddenly from a heart attack on 19th August 1957. He was born in 1898, in Stockholm where he also completed his University training. During leave of absence from the Swedish Meteorological and Hydrological Institute, where he spent some years as an assistant, he also studied under Professor Vilhelm Bjerknes in Bergen. In 1926, he went to the United States of America for a visit but stayed there to work at the Massachusetts Institute of Technology. There he established a meteorological department which he directed till 1939. For two years he was Assistant Director and Scientific Adviser with the United States Weather Bureau and in 1941, became Professor at the University of Chicago. After 6 years there, he was called back to Sweden as Professor at the University of Stockholm and Scientific Adviser at the Swedish Meteorological and Hydrological Institute. Thereafter he spent part of his time in Sweden and part of it in the United States.

Dr. Rossby was an outstanding scientist in meteorology and oceanography and pioneered research in many branches of these sciences. His earlier publications were on thermodynamics and friction in the atmosphere and in the ocean. His most valuable contributions were perhaps his demonstration of the importance in dynamical and synoptic meteorology of the variation with latitude of the Coriolis force and his theory of long circumpolar waves. Together with Professor E. Palmén, Rossby proved the

existence of the jet stream, and his work on the conservation of absolute vorticity became the basis for present numerical forecasting methods. In recent years he also took up studies of atmospheric chemistry.

At the International Meteorological Institute, which he created in Stockholm with support from UNESCO, he gathered specialists from the whole world for seminars and for informal discussions of important scientific questions. Advanced students and experts from more than 20 foreign countries worked for long periods at the Institute. The results of their activity has often been published in the geophysical journal *Tellus*, sponsored by the Swedish Geophysical Society and edited by Dr. Rossby.

Dr. Rossby also took an active part in the work of International Union for Geodesy and Geophysics (IUGG), in which he was President of the International Association of Meteorology of IUGG, and in the planning and preparation for the International Geophysical Year.

Dr. Rossby was certainly one of the world's most prominent scientific meteorologists and his ability to stimulate the enthusiasm of his students and colleagues was outstanding. Through his charm and his personality he also infected many who previously had little appreciation of the science of meteorology and its potentialities. The meteorological world suffers a great loss by his untimely death. (*WMO Bulletin*, October 1957.)

LETTERS TO THE EDITOR

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STUDY OF CURRENT VOLTAGE
CHARACTERISTICS OF n-p
CONTACTS ON GALENA

THE rectifying characteristics of metal semiconductor point contacts have been studied by a number of workers. We¹ have observed that the rectifying point contacts on H_2S -treated galena surfaces obey the theoretical relation $i = i_0 [\exp \alpha (V_a - iR_s) - 1]$. It was thought worthwhile to investigate the behaviour of rectifying contacts between galena crystals of n and p type, in view of similar work done by Granville, Henisch and Tipple² and Benzer.³

The natural n type galena crystals were heated to about 1,000° C. in a refractory mould. On slowly cooling them, the annealed crystals were found to possess large reflecting surfaces and gave n type diode characteristics. On heating these crystals to about 500° C. in an atmosphere of H_2S , the crystal surfaces were converted to p type due to sulphur penetration (Breck and Scanlon⁴), while the interior of the crystal remained n type, thus forming a p-n junction in the interior. Contacts between an n type crystal used as a whisker and the p type surface were established with a micro-

manipulator and the D.C. characteristics determined in the usual manner to test the validity of the relation $i = i_0 [\exp \alpha (V_a - iR_s) - 1]$.

On examining the i-v characteristics of the above system, it is observed that the forward direction currents tend to saturate to a value of 1.5 to 3 ma. A similar observation has been reported by Benzer (loc. cit.) for germanium. Metal point contacts on H_2S -treated galena crystals give similar saturation currents in the forward direction, the value of these saturation currents being of the same order as stated above. On making a large area contact on these H_2S -treated surfaces by a mercury drop with an apparent diameter of contact ≈ 3 mm., the saturation in the forward direction persists when observed on a cathode ray oscillograph.

The system under investigation consists of two rectifying barriers in series opposition: (1) at the contact between n type crystal used as a whisker and p type surface, and (2) at the p-n junction between the p type surface layer and the n type interior of the crystal. On making n type crystal (whisker) negative, the n-p contact is biased in the forward direction, and the junction in the reverse direction.

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As the applied potential is increased, the current flowing in the forward direction of n - p contact increases till it is limited by the reverse direction saturation current of the p - n junction inside the crystal. The large value of the saturation current (1.5-3 ma.) in the forward direction is thus due to the large effective area of the p - n junction. However, when the whisker is made positive, the n - p contact gets biased in the reverse direction and limits the forward direction current of the p - n junction to a value equal to the reverse direction saturation current of the n - p contact, which has a small area. Thus the observed i - v characteristics, excluding the saturation region in the forward direction, belong to the n - p contact. Hence, in order to investigate whether the equation $i = i_0 [\exp a(V_a - iR_s) - 1]$ is obeyed, the analysis is restricted to the portion of the curve belonging to the n - p contact only.

The analysis of n - p contacts for five different crystals indicates that the values of a range between .86 to 1.0 times the theoretical value e/kT indicating a close agreement with theory. A similar close agreement has been reported by Goucher⁵ and Shockley⁶ in the case of p - n junction. But the p - n junction theory cannot be applied to these contacts as the transition from n to p type region at the contact is discontinuous. The values of R_s , the spreading resistance are high: 100-600 ohms. Hence the actual contact area is much smaller than the apparent contact area (0.001 sq. cm.) as determined with a microscope.

In the case of one crystal (A_4P), with contact potential difference (c.p.d.) $\phi = 0.28$ volts, the value of a is much lower ($\approx .5 e/kT$). For the other crystals where the theoretical value of a is obtained, the c.p.d. is 0.13 to 0.2 volts. It therefore appears that n - p contacts can give the theoretical current voltage characteristics if the value of the c.p.d. ≤ 0.25 volts. This is to be expected in view of the earlier observations reported by us (loc. cit.).

Our thanks are due to Dr. V. N. Thatté for his valuable suggestions.

College of Science, P. V. KHANDEKAR.
Nagpur, July 15, 1957. J. N. DAS.

CHARACTERISTIC NUCLEAR TRANSPARENCY CURVE

RECENTLY, transparency curves have been plotted for various elements assuming a known nuclear density distribution.¹ Such a curve relates the observed inelastic cross-section to a function of the mean free path in nuclear matter, and therefore to the effective elementary cross-section K' defined as

$$K' = \frac{1}{2}(\sigma_{pp} + \sigma_{np})$$

where σ_{pp} and σ_{np} are scattering cross-sections for (p, p) and (n, p) scattering respectively. Here the exclusion factor is taken as unity. It is also possible to plot transparency curves by using Glauber approximation, as discussed by Gatha and Mathur.² In this approximation the expression for the absorption cross-section σ_a is given as

$$\sigma_a = 2\pi \int_0^\infty \xi d\xi [1 - e^{-2K'\tau(\xi)}] \quad (1)$$

in which

$$\tau(\xi) = \int_0^\infty \rho [(t^2 + z^2)^{1/2}] dt$$

where $\rho(r)$ is the nuclear density distribution for the element and (ξ, Z) represent the cylindrical co-ordinates. Thus there will be a set of transparency curves, one for each element.

One can now introduce the characteristic nuclear density distribution $\rho(\bar{r})$ as defined by Gatha, Shah and Patel³ while analysing the experimental data on the nuclear scattering of 340 Mev. protons by light nuclei on the basis of the first Born approximation. In this definition $\rho(\bar{r}) = \rho(r)$ for all nuclei where $\bar{r} = r \times A^{-1/3}$. The above expression for the absorption cross-section σ_a can now be written as

$$\sigma_a = 2\pi A^{2/3} \int_0^\infty \bar{\xi} d\bar{\xi} [1 - e^{-2\gamma_2 \bar{\tau}(\bar{\xi})}] \quad (2)$$

where

$$\gamma_2 = K' \times A^{1/3}, \quad \bar{\xi} = \xi \times A^{-1/3}, \quad \bar{z} = z \times A^{-1/3}$$

and

$$\bar{\tau}(\bar{\xi}) = \int_0^\infty \bar{\rho} [(\bar{t}^2 + \bar{z}^2)^{1/2}] d\bar{t}$$

It is interesting to observe from equation (2), that if the concept of a characteristic nuclear density distribution is true, there will be a characteristic transparency curve, common to all elements, when $\sigma_a/2\pi A^{2/3}$ is plotted as a function of the independent variable γ_2 .

In the present investigation, experimental values of σ_a at 305 Mev.,⁴ 860 Mev.⁵ and 1.4 Bev.⁶ have been used while γ_2 has been calculated for each element in the above energy range from

1. Bhide, V. G., Das, J. N. and Khandekar, P. V., *Proc. Phys. Soc.*, 1956, **69 B**, 245.
2. Granville, J. W., Henisch, H. K. and Tipple, P. M., *Ibid.*, 1952, **65 B**, 651.
3. Benzer, S., *Phys. Rev.*, 1947, **72**, 1267.
4. Brebrick, R. F. and Scanlon, W. W., *Ibid.*, 1954, **96**, 698.
5. Goucher, F., *Ibid.*, 1951, **81**, 637.
6. Shockley, W., *Bell. Syst. Tech. J.*, 1951, **28**, 435.

the experimental values of σ_{np} and σ_{pp} as given by Chen *et al.*⁷ The plot of $\sigma_a/2\pi A^{2/3}$ with the corresponding errors against the independent parameter γ_2 is shown in Fig. 1. Since all the

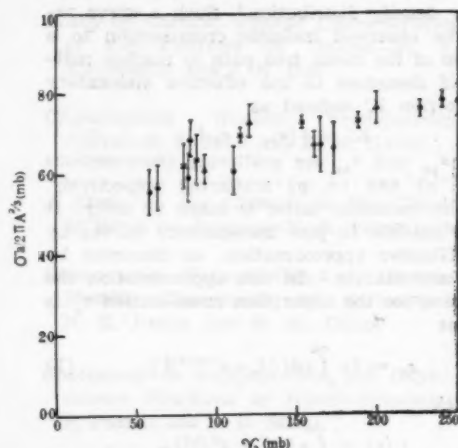


FIG. 1. Experimental Characteristic Nuclear Transparency Curve. Full circles represent 305 Mev, crosses represent 860 Mev, while closed triangles represent 1.4 Bev.

points lie approximately on a smooth curve, one can conclude that there exists a characteristic transparency curve to which any proposed characteristic nuclear density distribution must be consistent. The small deviations from the general trend may be ascribed to systematic errors in the values of σ_a , the uncertainties inherent in the Glauber approximation and the approximate nature of the concept of a characteristic nuclear density distribution.

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Mayo Road, Bombay-1,
September 17, 1957.

K. M. GATHA.

1. Brenner, A. E. and Williams, R. W., *Phys. Rev.*, 1957, **106**, 1020.
2. Gatha, K. M. and Mathur, A. L., *Curr. Sci.*, 1955, **24**, 43.
3. —, Shah, G. Z. and Patel, N. J., *Proc. Phys. Soc.*, 1954, **67 A**, 773.
4. Millburn, G. P., Birnbaum, W., Crandall, W. E. and Schecter, L., *Phys. Rev.*, 1954, **95**, 1209.
5. Chen, F. F., Leavitt, C. P. and Shapiro, A. M., *Ibid.*, 1956, **99**, 857.
6. Coor, T., Hornyak, D. A., Smith, W. F. and Snow, G., *Ibid.*, 1955, **98**, 1309.
7. Chen, F. F., Leavitt, C. P. and Shapiro, A. M., *Ibid.*, 1956, **103**, 211.

A STUDY ON THE CHANGES IN THE COLOUR OF BERYL ON HEATING*

BERYL is known to occur in different colours ranging from blue to yellow. It has been reported that the bottle green, green and yellowish green varieties change to blue on heating while the blue, pale blue and colourless varieties do not show any change in colour.^{1,2} It has been observed in this investigation that the bluish variety of beryl undergoes considerable changes in colour on heating, details of which are presented herein.

The beryl sample studied was from Nellore, Andhra State. It was of the bluish variety, semi-transparent in small pieces and had greenish and greenish-yellow patches. Small pieces of $\frac{1}{2}$ – $\frac{3}{4}$ " were carefully broken from a big lump. Separate samples were heated in a platinum dish inside an electrical muffle furnace for three hours each at different temperatures, upto 1,100° C. at 100° C. intervals, cooled gradually and examined. The mineral was also fused at 1,540° C. in a carbon resistance furnace.

While it has been reported previously that the green beryl changes to blue on heating to about 500° C., it has been observed in this investigation that the greenish tinge begins to disappear at about 200° C., resulting in the development of a brown colouration, though the blue colour remains unaffected. However, with a progressive increase in temperature, there is to be seen an intensification of the brown with a dullening of the blue colour. The brown colour intensifies from 500° C. and at 700° C. the light blue tends to change together with the development of opalescence. Dark brown patches are observed at 900° C. and the specimen develops a grey colour with persistence of opalescence. At 1,100° C. the specimen shows a darkish grey-blue colour, with brown streaks interspersed. After fusion, beryl becomes ash-coloured, light and porous.

The change of colour from green to brown is indicative of the conversion of ferrous iron to the ferric state and it has been ascertained that the change is not superficial. It has been shown by chemical analysis that the Nellore beryl corresponds to the formula $6(\text{BeO FeO Na}_2\text{O}) \cdot 2(\text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3) \cdot 12 \text{SiO}_2 \cdot \frac{1}{2} \text{H}_2\text{O}$ and that there is a significant increase in the ferric iron content in green and greenish yellow samples heated at 500° C.

The author is thankful to Prof. Brahm Prashad for his interest in this investigation and to Mr. P. R. Gopinathachar for assistance.

Chilai Steel Project, N. R. SRINIVASAN.
Burg, July 31, 1957.

* This investigation was carried out at the Department of Metallurgy, Indian Institute of Science, Bangalore.

1. Kurbatov and Kargin, *Centr. Mineral Geol.*, 1927 A, 361 (*C.A.*, 1928, 22, 1303).

2. Jayaraman, *Quart. J. Ind. Inst. Sci.*, 1940, 23 A, 30.

DIAMAGNETIC SUSCEPTIBILITY OF ORGANO-METALLIC COMPOUNDS OF ANTIMONY

The diamagnetic susceptibility of a series of organo-antimony compounds of the type R_3Sb and their dihalides R_3SbX_2 have been investigated. Only a few organo-metallic compounds of antimony have been studied previously by Pascal¹ who deduced the susceptibility value of the antimony atom.

The compounds studied in this investigation have been prepared by the known methods and they have been purified at least twice before measurements. Their melting points and the percentage metal contents have been determined to establish their purity. The susceptibilities were determined by a modified form of Gouy's method² and the results of these measurements are given in Table I in which χ_s repre-

sents the specific susceptibility values and χ_m their molar susceptibilities. These values are expressed in terms of -1×10^{-6} c.g.s. units.

Only one compound, namely, triphenyl stibine, has been studied previously by Pascal (*loc. cit.*) who obtained the value of $\chi_s = 0.516 \times 10^{-6}$. The observed value for this compound agrees well with the reported value.

The susceptibility values of tri- and penta-valent antimony atom have been deduced from the molar susceptibilities, using Pascal's values of other atoms and constitutive correction constants³; the average values of χ_{Sb}^{+3} and χ_{Sb}^{+5} were thus found to be -24.70×10^{-6} and -15.50×10^{-6} , respectively. It is obvious that these values of tri- and penta-valent Sb atom are inclusive of the effects of C-Sb and Sb-halogen bonds. These results apparently support the observation made by Kido⁴ who found the difference in the susceptibility of tri- and penta-valent atoms of P, As and Cl is of the order of 8-10 units.

Institute of Science,
Bombay,
September 20, 1957.

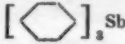
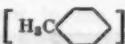
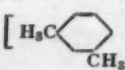
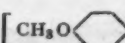
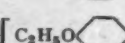
N. K. PARAB.
D. M. DESAI.

1. Pascal, *Compt. Rend.*, 1921, 173, 144, 712; 1922, 174, 437, 1698; 1927, 175, 1003.

2. Gouy, *Ibid.*, 1889, 935, 100.

3. Bhatnagar and Mathur, *Physical Principles and Applications of Magneto-Chemistry*, Ed. 1935, 90-93.

4. Kido, *Sci. Rep. Tohoku Imp. Univ.*, 1932, 21, 869-81.

No.	Compound	Formula	χ_s	χ_m	χ_{Rr}	χ_{Sb}
1	Triphenyl stibine	 Sb	0.5169 ± 0.004	182.3	156.27	26.03
2	Tri- <i>p</i> -tolyl stibine	 Sb	0.5484 ± 0.003	216.6	191.85	24.75
3	Tri- <i>m</i> -xylyl stibine	 Sb	0.5750 ± 0.003	251.1	227.43	23.67
4	Tri- <i>p</i> -anisyl stibine	 Sb	0.5198 ± 0.003	230.1	205.68	24.42
5	Tri- <i>p</i> -phenetyl stibine	 Sb	0.5486 ± 0.003	205.9	241.26	24.04
6	Triphenyl stibine dichloride	$(C_6H_5)_3SbCl_2$	0.5077 ± 0.003	215.1	196.47	18.63
7	Tri- <i>p</i> -tolyl stibine dichloride	$(CH_3-C_6H_4)_3SbCl_2$	0.5361 ± 0.003	249.2	232.05	17.15
8	Tri-benzyl stibine dichloride	$(C_6H_5CH_2)_3SbCl_2$	0.5359 ± 0.003	249.6	232.05	17.55
9	Triphenyl stibine dibromide	$(C_6H_5)_3SbBr_2$	0.4532 ± 0.003	232.4	217.47	14.93
10	Tri- <i>p</i> -tolyl stibine dibromide	$(CH_3-C_6H_4)_3SbBr_2$	0.4821 ± 0.002	287.4	253.05	14.35
11	Tri- <i>m</i> -xylyl stibine dibromide	$[(CH_3)_2C_6H_3]_3SbBr_2$	0.5040 ± 0.003	300.7	288.63	12.07
12	Triphenyl stibine diiodide	$(C_6H_5)_3SbI_2$	0.4303 ± 0.003	261.1	245.47	15.63
13	Tri- <i>p</i> -tolyl stibine diiodide	$(CH_3-C_6H_4)_3SbI_2$	0.4551 ± 0.003	295.3	281.05	14.25

CHOLESTEROL IN γ -LIPOPROTEIN AND CHYLOMICRON FRACTIONS OF BLOOD

THE importance of estimation of lipid complexes including cholesterol in blood as an aid to diagnosis and prognosis of many diseases, particularly atherosclerosis and coronary artery disease has attracted considerable attention during recent years.¹ During routine estimations of cholesterol in these conditions, it appeared desirable to fractionate the lipid complexes (lipoproteins) and to estimate the cholesterol content of each. The lipoproteins from sera of services personnel, both normal and pathological subjects, were separated by electrophoresis, and cholesterol estimated according to the method of Anderson and Keys.²

This report indicates that, besides the two well recognised fractions of α - and β -lipoproteins, an additional fraction of γ -lipoprotein exists in serum of adults and that a significant proportion of the serum total cholesterol may be present in this fraction and in chylomicrons.

ed strips was considerably less than the total cholesterol values obtained from fresh serum or serum air-dried on filter-paper. A search for this deficiency of cholesterol in the electrophorised strips led us to the finding that the missing cholesterol was mostly present in the portion of the strip between the point of application and the boundary of β -lipoprotein band. It appears that Anderson and Keys considered this portion as a part of the β -lipoprotein fraction.

In the strips stained with Sudan Black B solution, the following two additional lipid components are seen (Figs. 1 and 2):

- (a) γ -lipoprotein.—A rather diffuse band, sometimes not so easily discernible, adjacent to the β -lipoprotein band and almost level with γ -globulin. In the unstained strip, this band fluoresces lightly under ultraviolet light.
- (b) A "fatty trail".—Consisting of chylomicrons or neutral fats and extending from the line of application upto the γ -lipoprotein.

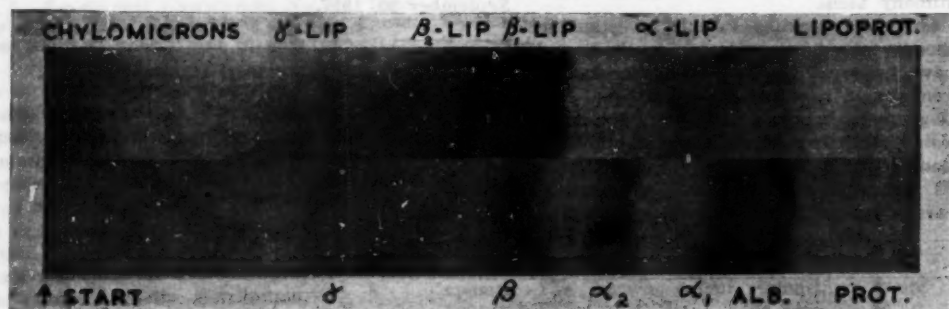


FIG. 1 (Normal).



FIG. 2 (Hydronephrosis).

Contrary to the observations of Anderson and Keys (*loc. cit.*) it was noted by us that the sum-total of cholesterol extracted from the α - and β -lipoprotein fractions of electrophorised

cholesterol has been found in both these fractions in significant quantities (21.14% with S.D. 3.62 of total cholesterol in γ -lipoprotein and 18.68% with S.D. 7.11 in chylomicrons) in nor-

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mal as well as pathological cases, e.g., myocardial infarction, hepatic cirrhosis and hydro-nephrosis. The presence of cholesterol in chylomicrons has also been demonstrated by Dangerfield³ and Bragdon et al.⁴ though upto about 9% of the serum total cholesterol values, while γ -lipoprotein is reported to be present in normal infants (Frieslederer and Kopetz⁵) and in a boy of 20 months having biliary cirrhosis with cutaneous xanthomas (Dangerfield³).

It is well known that β -lipoprotein and β -lipoprotein cholesterol levels are elevated in atherosclerosis and coronary artery disease. However, with the limited data that we have obtained so far (7 normals and 10 pathological cases), it is premature to assess the significance of γ -lipoprotein cholesterol in the human system. Further work to study if this lipid component has a relationship with any clinical condition and/or any specific pathological lesion, is in progress.

Armed Forces Medical College, Poona-1,
PARAMJIT R. PABRAI.
K. B. SEHRA.
September 8, 1957.

1. Leading article, *Lancet*, 1957, 1, 141.
2. Anderson, J. T. and Keys, A., *Clin. Chem.*, 1956, 2, 145.
3. Dangerfield, W. G., *Proc. Roy. Soc. Med.*, 1956, 49, 1085.
4. Bragdon, J. H., Havel, R. J. and Boyle, E., *J. Lab. Clin. Med.*, 1956, 48, 36.
5. Frieslederer, W. and Kopetz, K., *Klin. Wschr.*, 1956, 34, 1198 (*Thro' Internat. Abst. Biol. Sci.*, 1957, 6, 53).

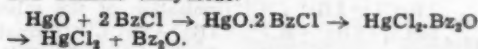
BENZOYL CHLORIDE AS A POLAR SOLVENT

IN view of a recent publication, "The solvent benzoyl chloride",¹ we wish to place on record our own findings with regard to the use of benzoyl chloride as a polar solvent.

A quantitative determination of the solubilities of a number of chlorides, oxides and other salts in benzoyl chloride, has been carried out at $30 \pm 0.10^\circ \text{C}$. It has been found that in general, the strongly ionic compounds are insoluble while the covalent compounds are mostly soluble. Lewis acids, quaternary ammonium chlorides and tertiary bases belong to the latter class. An examination of the solid phase obtained in the solubility determination of these compounds has revealed that electrovalent compounds are reluctant towards solvate formation. Magnesium oxide, manganese chloride and antimony pentachloride form monosolvates, while quinoline forms disolvate with benzoyl chloride. Solvates are also formed

by pyridine and α - and β -picoline, but they are too hygroscopic and unstable to be properly analysed.

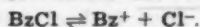
Benzoyl chloride acts as a fairly good solvolysing agent and in some cases this affords a very convenient method for preparing anhydrous chlorides. Thus, cupric, zinc, mercuric and lead oxides and selenium dioxide get solvolysed to give corresponding chlorides. Cadmium, calcium and nickelous oxides are also converted to chlorides but the reaction is very slow. The solvolysis increases with time. Aluminium, chromium, nickelic oxides and titanium dioxide are not solvolysed. Isolation of an intermediate $2\text{ZnCl}_2 \cdot 3(\text{ZnO} \cdot 2\text{BzCl})$ on solvolysis of zinc oxide at room temperature and the formation of pure zinc chloride at higher temperatures, support the view² that with oxides an addition compound is first formed, which rearranges to give the chloride and benzoic anhydride.



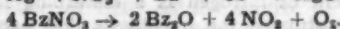
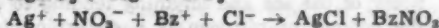
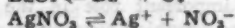
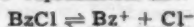
It has been observed that in the case of some of the oxides, the benzoic anhydride formed remains attached to the chloride. Thus bismuth oxychloride and bismuth trioxide on solvolysis give $\text{BiCl}_3 \cdot \text{Bz}_2\text{O}$ and $2\text{BiCl}_3 \cdot 3\text{Bz}_2\text{O}$ respectively, while antimony oxychloride and antimony trioxide both give $\text{SbCl}_3 \cdot \text{Bz}_2\text{O}$. The structure of these compounds has been confirmed by their preparation, by reacting the corresponding chlorides and benzoic anhydride in benzoyl chloride solution.

Silver nitrate, sodium nitrate, sodium nitrite, potassium oxalate, mercuric acetate, cadmium carbonate and cadmium sulphide are solvolysed to give pure chlorides, while with potassium sulphite, the solvolysis is very slow.

These solvolytic reactions can only be explained on the basis of the ionisation of benzoyl chloride as:



A typical solvolytic reaction of the nitrates can be represented as:



Similarly with oxalates, nitrites and carbonates, benzoyl oxalate, nitrite and carbonate are first formed which further decompose to give carbon dioxide and carbon monoxide, oxides of nitrogen and carbon dioxides respectively, along with benzoic anhydride which remains in solution. With sulphides, dibenzoyl sulphide is formed. Acetates also undergo

solvolysis with the formation of anhydrous chlorides and benzoic and acetic anhydrides.

Neutralisation reactions in benzoyl chloride between stannic chloride, zirconium tetrachloride, titanium tetrachloride and tellurium tetrachloride as solvo acids and dimethylphenylbenzylammonium chloride, pyridine, quinoline and α - and β -picolines as bases have been studied and the following neutralisation complexes or salts, formed by their interaction, have been isolated:

$(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)_2 \text{SnCl}_4$; $(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)_2 \text{ZrCl}_4$; $(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)_2 \text{TiCl}_4$; $(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)_2 \text{TeCl}_4$; $(\text{C}_6\text{H}_7\text{N}) \text{Bz}_2\text{ZrCl}_4$; $(\text{C}_6\text{H}_7\text{N}) \text{Bz}_2\text{ZrCl}_4$; $(\text{C}_6\text{H}_7\text{N}) \text{Bz}_2\text{ZrCl}_4 \cdot \text{BzCl}$; $(\text{C}_6\text{H}_7\text{N}) \text{BzTeCl}_4$; $(\text{C}_6\text{H}_7\text{N}) \text{BzSnCl}_4$; $(\text{C}_6\text{H}_7\text{N}) \text{TiCl}_4 \cdot \text{BzCl}$; $(\text{C}_6\text{H}_7\text{N}) \text{BzTiCl}_4$.

A typical reaction between dimethylphenylbenzylammonium chloride and stannic chloride can be represented as:

$2 \text{BzCl} \rightleftharpoons 2 \text{Bz}^+ + 2 \text{Cl}^-$ (ionisation of the solvent)
 $\text{SnCl}_4 + 2 \text{Bz}^+ + 2 \text{Cl}^- \rightleftharpoons 2 \text{Bz}^+ + \text{SnCl}_6^{2-}$ (formation and ionisation of acid solvate)
 $2(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7) \text{Cl} \rightleftharpoons 2(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)^+ + 2 \text{Cl}^-$ (ionisation of base)
 $2(\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)^+ + 2 \text{Cl}^- + 2 \text{Bz}^+ + \text{SnCl}_6^{2-} \rightarrow (\text{Me}_2\text{N.C}_6\text{H}_5, \text{C}_7\text{H}_7)_2 \text{SnCl}_4 + 2 \text{BzCl}$ (neutralisation).

Further work on the conductivity of acids, bases and the salts in benzoyl chloride and conductometric titrations, which is being carried out in this laboratory, supports the proposed ionisation of benzoyl chloride.

Dept. of Chemistry, RAM CHAND PAUL.
 Panjab University, GURDEV SINGH.
 Hoshiarpur, November 8, 1957.

1. Gutmann, V. and Tannenberger, H., *Monatsh. Chem.*, 1957, **88**, 216; cf. *C.A.*, 1957, **51**, 11817.
2. McGookin and Page, *J. Chem. Soc.*, 1951, 2769.

NITRATE-REDUCING BACTERIA FROM MARINE ENVIRONMENT

NITRATES play an important role in the economy of the sea and anything tending to affect the content of nitrogen is a disturbing factor. Brandt postulated the hypothesis that bacterial destruction of nitrates limited the growth of phytoplankton in the tropical seas. Zobell (1946) found that 50% of the bacteria from sea-water reduced nitrates to nitrites, and a small percentage further reduced it to nitrogen. Nitrate-reducing ability of different types, however, has not been worked out. From a study of 424 cultures from sea-water and other

marine materials, the nitrate-reducing activities of these have been assessed in pure culture.

Out of 424 marine cultures, as many as 218 reduced nitrates (55%) and 37 (8.7%) even produced gaseous nitrogen. *Pseudomonas* was by far foremost in nitrate reduction (93%) whereas in the other genera nitrate reducers were less than 50%. Micrococci generally are nitrate reducers, 57.5% of them reducing nitrates to nitrite stage. In the aerobic spore forming *Bacillus*, only 42% are nitrate reducers. Generally *Bacillus* are strongly gelatinolytic and in many cases, those which hydrolysed gelatin did not reduce nitrates and vice versa. Similarly, denitrifying *Pseudomonas* were, to a large extent, non-liquefiers of gelatin. Denitrification was marked in the genus *Pseudomonas* (including vibrios) while it was spasmodic in other genera such as *Flavobacterium*, *Bacterium* and *Achromobacter*. The others did not prove to be denitrifiers. Nitrate reducers and denitrifiers were found to be more common in benthic animals like chank and Pearl oysters, in bottom sand and in surface waters than on fish. Bacteria, in marine environment, are generally nitrate reducers. Reduction of nitrate to nitrite by itself is not of great importance, since nitrites or even ammonia are assimilated by plankton. But nitrite is a very unstable form, being either oxidized to nitrates or reduced to gaseous nitrogen. Denitrifying bacteria occur in quite a large proportion, in our marine environment. This in the light of Brandt's hypothesis, may explain the low nitrate content in tropical waters. In fact, Jayaraman (1955) found very low content of nitrates in the East Coast. The present consensus of opinion is not fully in support of Brandt's view but the work of Venkataraman and Sreenivasan (1957) does not contradict Velankar's (1955, 1957) work confirms our findings on the abundance of nitrate-reducing and denitrifying bacteria in the sea. Of particular interest is the fact that the denitrifiers were mostly *Pseudomonas* capable of growing at 37°C. and that all but 3 out of the 41 examined were nitrate reducers, while 30 were denitrifiers. Thus nitrate reduction and to a great extent denitrification seems to be a generic trait of *Pseudomonas* from marine sources. *Micrococcus* and *Achromobacter* are next in importance to *Pseudomonas* as nitrate reducers. The importance of denitrifying bacteria in fouling (Sreenivasan, 1956), and in precipitation of calcium carbonate (Venkataraman and Sreenivasan, 1957), has been brought out in our earlier work.

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ment given by Sri. R. Venkataraman is gratefully acknowledged.
Fisheries Tech. Station, A. SREENIVASAN.*
Kozhikode, October 9, 1957.

* Present Address: Fisheries Biological Station, Bhavanisagar (S. India).

1. Zobell, C. E., *Marine Microbiology*, Chronica Botanica Co., Waltham, Mass., 1948.
2. Waksman et al., *Biol. Bull.*, 1:33, 64, 183.
3. Jayaraman, R., *Ind. J. Fish.*, 1954, 1, 345.
4. Velankar, N. K., *Ibid.*, 1955, 2, 96; 1957, 4, 208.
5. Sreenivasan, A., *Curr. Sci.*, 1956, 25, 92.
6. Venkataraman, R. and Sreenivasan, A., *Proc. Natl. Inst. Sci.*, 1957, 22 (6), 357.

THE EFFECT OF HYDROGEN-ION CONCENTRATION ON THE UTILIZATION OF POTASSIUM NITRITE BY COLLETOTRICHUM GLOEOSPOROIDES PENZ.

POTASSIUM NITRITE was added in amount calculated to furnish 693 mg. of nitrogen per litre of the basal medium [Dextrose 20 g., $MgSO_4$ 0.5 g., KH_2PO_4 30 g., $Fe_2(SO_4)_3 \cdot 6H_2O$ 0.005 g.]. Growth of *Colletotrichum gloeosporoides* Penz. produces alkalinity in the medium which, however, was well buffered with 30 g. of KH_2PO_4 per litre of the medium. The initial pH of the medium was adjusted to 2, 4, 6, 8, 10 and 12 after autoclaving. As it is quite evident from Table I, *C. gloeosporoides* did not show any growth at pH 2, 4 and 6 after 10 days' incubation at 28° C. Incidentally, pH 4 is optimum pH when potassium nitrate was added as a source of nitrogen. At pH 8 the fungus showed best growth which was equal (or even slightly more) to that produced with potassium nitrate at the same pH (i.e., 350 mg. per 50 c.c. of the medium with potassium nitrite against 330 mg. with potassium nitrate under the same conditions). Growth at pH 10 was less but still fairly good. There was of course no growth at pH 12 both with potassium nitrite and potassium nitrate. It is quite evident that potassium nitrite is toxic to the growth of *C. gloeosporoides* only in the acidic medium while it is very efficiently

TABLE I

Effect of hydrogen-ion concentration on the utilization of potassium nitrite by *Colletotrichum gloeosporoides* after 10 days' incubation at 28° C.

Compounds used	pH Range					
	2	4	6	8	10	12
Potassium nitrate	..	0	416*	390	330	215
Potassium nitrite	..	0	0	0	350	136

* Dry weight of the mycelial growth of the fungus in mg.

utilized in the alkaline medium. This is in accord with the conclusion of Cochrane, 1950, Cochrane and Conn, 1950, and Brock, 1951, with other fungi.

The authors are deeply indebted to Prof. P. N. Mehra for providing facilities and encouragement.

Dept. of Botany, K. S. THIND.
Panjab University, (MISS) LIVLIN DUGGAL.
Amritsar, August 2, 1957.

1. Brock, T. D., *Mycologia*, 1951, 43, 402.
2. Cochrane, V. W. and Conn, J. E., *Bull. Torr. Bot. Club*, 1950, 77, 10.
3. Cochrane, V. W., *Ibid.*, 1950, 77, 176.

EFFECTIVE CONTROL OF SHOOT-BORERS OF SUGARCANE BY SOIL APPLICATION OF GAMMA BHC LIQUID

THERE are three species of borers, *Chilo traca infuscatellus* Snell., *Raphimatopus ablutella* Zell. and *Emmalocera depressella* Swinh., which attack sugarcane shoots during hot weather. Their attack results in the mortality of young plants. Foliage application of organic insecticides has not proved very successful against these pests, and it still remains an unsolved problem.

In a field experiment on termite control by soil application of BHC, chlordane and aldrin at Shahjahanpur in 1957, it was noted that technical gamma BHC at a dose of 1.25 lb. per acre, not only checked termite incidence to cane setts and buds, but also effectively controlled the shoot-borers. The insecticide was applied in emulsion form at a dosage of 180 gallons per acre with a gardener's can over the cane setts at the time of planting. The results showed that the average incidence of 40% of shoot-borers was reduced to 3.9%. The reduction in dead heart was 90%. As a result of effective control of termite and the shoot-borers, the number of tillers was increased from 40.1 thousand in the control to 96.7 thousand per acre in the treated plots. Gupta (1953) also recorded the effect of soil application of BHC on the control of shoot-borers. But the results obtained in this experiment have excelled all previous records on shoot-borer control either by soil application or by foliage spraying of insecticides. The control of these borers, which migrate to the root region of the plant at the prepupal stage, is believed to be due to the fumigant effect of the insecticide. The cost has been worked out Rs. 50 per acre, but the investment is expected to have

a good return by way of appreciable extra yield. Detailed data will be published shortly.

Cane Entomologist,
Main Sugarcane Research
Station, Shahjahanpur,
November 6, 1957.

Z. A. SIDDIQI.

1. Gupta, B. D., *Curr. Sci.*, 1953, 22 (10), 319.

FURTHER STUDIES ON RED TAMARIND

A LITTLE-KNOWN variety of tamarind (*Tamarindus indica*, Linn.), the red tamarind berry contains a deep red pigment identified by us as the anthocyanin, chrysanthemin.¹ The commoner variety contains a colourless leucoanthocyanin.

We have proceeded to study the flowers of the two varieties morphologically as to where the pigmentation starts and the chemical composition of the ripe fruits when stability has been reached.

Study of the morphology of the flower of red tamarind did not show any peculiarity in so far as general floral construction is concerned. Flowers in both the varieties are zygomorphic, bi-sexual with a floral formula of:

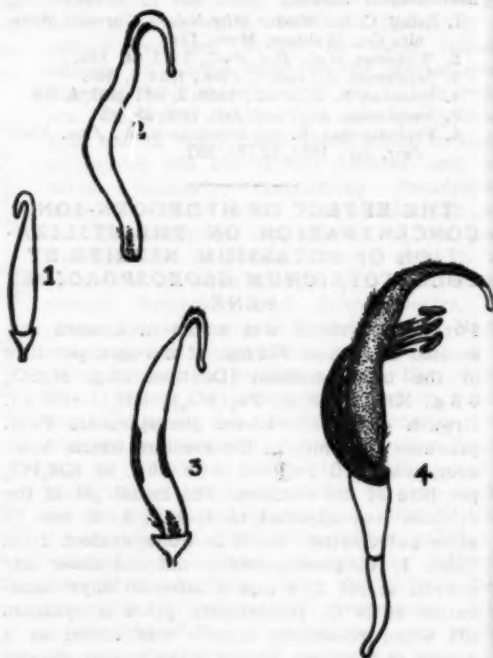
$K_4, C_3, A(3), G 1$

The sepals and petals are all veined red in red tamarind flower whereas in the common variety only petals are red-veined.

Study of the gynaeceum in case of the red tamarind flower has revealed certain noted peculiarities. All parts of the pistil in this variety are deep red in colour. Not only the pistil, but even the staminal sheath and staminal filaments are all bright red in colour. Contrastingly, the flowers of the common variety did not show colouration either in androeceum or in the gynaeceum.

Flowers of red tamarind at different stages of maturity were studied in order to study the nature and origin of pigment in pistil tissue. It has been observed that the pistil very early in its development does not show any trace of red colour, whereas slightly older flowers show the origin of pigmentation. The initiation of pigmentation is seen to take place at two regions in the pistil, viz., basal portion of style and at base of the ovary. The initiation of pigment is simultaneous at these regions. Subsequently strips of red bands also appear at both dorsal and ventral portions of the body of the ovary. Pistils from the mature flowers show complete pigmentation in all the parts. A study of free-hand transverse sec-

tions at different regions of the pistil has revealed that the pigment is located in sub-epidermal layers of the ovary. As the flower fully matures the pigment diffuses to all parts of the ovary thereby rendering the entire ovary deep red in colour.



FIGS. 1-4. Semi-Diagrammatic Sketches of Pistils of Red Tamarind Flower to show Origin and Development of Red Pigment. Fig. 1. Pistil from very young flower bud (No trace of origin of pigment in the pistil.) Fig. 2. Pistil from slightly older flower-bud. (Figure shows origin of red pigment, stippled areas show the regions of pistil where pigment originates.) Fig. 3. Pistil from young opened flower showing the pigment originating from middle of ovary. Fig. 4. Pistil from mature flower. (The entire pistil is completely red in colour.)

The chemical analysis was done on fully mature fruits (as at time of harvest). Ripe fruits plucked from trees were cleaned of shell, fibre and seeds and the clean pulp used for the analysis. There was not much difference in composition of pulp of the same variety from tree to tree. Standard methods of A.O.A.C. were used.² The average values are given in Table I.

The only significant difference in the composition of the two fruits, apart from the higher pectin content in the red variety, is the high proportion of combined acid in the red as compared to the high proportion of free acid in

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TABLE I

Constituents	Red variety	Common variety
	%	%
Moisture	20.1	18.2
Tartaric acid free	6.6	9.8
Tartaric acid combined	11.4	6.7
Invert sugars	36.4	38.2
Pectin	4.4	2.4
Protein	3.1	2.8
Ash	4.2	2.8
Cellulosic residue	13.0	10.4

the common varieties. This is also indicated by the higher ash percentage in the former. This reasonably accounts for the red variety being reputedly 'sweeter'. The acid is present in combined form mostly as potassium bitartrate, and to a small extent as calcium tartrate.

The colour of the flesh of the red tamarind berries changes gradually from blood-red in the early stages to pink as maturity is reached, the decrease in the proportion of free acid bringing about a change in tint of the anthocyanin pigment.

The authors are grateful to Dr. V. Subrahmanyam, Director, for his kind interest and valuable suggestions.

Central Food Tech. Res. Y. S. LEWIS.

Inst., Mysore,

C. T. DWARAKANATH.

July 18, 1957.

D. S. JOHAR.

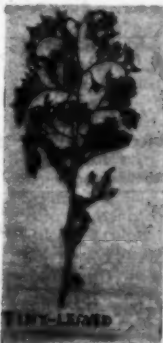
1. Lewis, Y. S. and Johar, D. S., *Curr. Sci.*, 1956, 25, 325.

2. *Official and Tentative Methods of Analysis* (Ass. of agric. chem., Washington), 1945.

OCCURRENCE AND INHERITANCE OF THE *FASCICULIFOLIA* FORM IN *CICER ARIETINUM* L.

A GRAM PLANT with fascicular leaflets was described by Argikar (1952) who recorded its occurrence as a mutant form. Interestingly enough, the same type has recurred in the second hybrid generation of a cross between the *tiny-leaf* mutant (Ekbote, 1937) and the variety *gigas* (Argikar, 1952) made by the authors in 1953. The *fasciculifolia* plant can be said to be a combination of the clustered leaflets of the *tiny-leaf* mutant, somewhat enlarged, and the unusually large-sized stipule and pod of the *gigas* type.

The *tiny-leaved* mutant was stated by Ekbote (1942) to behave as a recessive to normal, determined by a pair of genes designated as *tlv tlv*. Recently, Singh and Bhagchandani (1953), have reported the genetics of some leaf mutations of *Cicer* designating the *tiny-leaved* form as *Slv*



Slv tlv tlv Nlv Nlv and establishing that the production of the normal pinnate leaf in gram is governed by the interaction of three dominant genes, *Slv*, *Tlv* and *Nlv*. The author (Argikar: unpublished) has found that the variety *gigas* is a simple recessive to the normal inherited in a monogenic manner and that it is also complementary to the *tiny-leaved* form, the interaction of the two producing the normal-leaved condition.

The data obtained as a result of the work done by the authors independently at Bijapur and Nipad is presented below:

I. DATA COLLECTED AT BIJAPUR

Cross: $\frac{\text{Tiny-leaved mutant}}{\text{tlv tlv Glv Glv}} \times \frac{\text{Gigas}}{\text{Tlv Tlv glv glv}}$
F₁: Normal-leaved (bipinnate compound)
 $\frac{\text{Tlv tlv Glv glv}}$

F₂ frequencies

	Normal leaved	Tiny leaved	Gigas type	Fasciculi- folia
Observed	278	75	88	14
Expected on 9:3:3:1 ratio	253.04	85.31	85.31	26.44

F_3 segregation

S. No.	F_2 phenotype	No. of F_3 progenies	Breeding true or segregating for	Frequency	Ratio	X^2	P
1	2	3	4	5	6	7	8
1	Normal-leaved	20	Normal-leaved	1187	..	..	..
2	Normal-leaved	39	Normal : tiny	1553 : 487	3 : 1	1.38	0.20-0.50
3	Normal-leaved	37	Normal : <i>gigas</i>	1483 : 505	3 : 1	0.17	0.50-0.95
4	Normal-leaved	88	Normal : tiny : <i>Gigas</i> : <i>Fasciculifolia</i>	2617 : 875 : 854 : 262	9 : 3 : 3 : 1	2.844	0.20-0.50
5	<i>Tiny-leaved</i>	15	<i>Tiny-leaved</i>	418	..	..	..
6	<i>Tiny-leaved</i>	26	<i>Tiny</i> : <i>Fasciculifolia</i>	557 : 183	3 : 1	0.028	0.5-0.95
7	<i>Gigas</i> -Type	17	<i>Gigas</i> -type	123	..	..	..
8	<i>Gigas</i> -type	27	<i>Gigas</i> : <i>Fasciculifolia</i>	194 : 69	3 : 1	0.214	0.10-0.20
9	<i>Fasciculifolia</i>	1	<i>Fasciculifolia</i>	7	..	..	..

$X^2 = 10.49$; P between 0.01 to 0.02. The fit is good.

II. DATA COLLECTED AT NIPHAD

The F_2 frequencies obtained were as follows:

	Normal-leaved plants	<i>Tiny-leaved</i>	<i>Gigas</i>	<i>Fasciculifolia</i>
Observed No.	45	15	16	6
Expected on a 9 : 3 : 3 : 1 ratio	46.1	15.4	15.4	5.1

$X^2 = 0.17$; P between 0.95 and 0.99. The fit is good.

The F_3 segregation was of the following nature:

1	2	3	4	5	6	7	8
1	Normal-leaved	3	Normal-leaved	..	..	..	..
2	Normal-leaved	7	Normal : <i>Tiny</i>	95 : 36	3 : 1	0.430	0.50-0.95
3	Normal-leaved	12	Normal : <i>Gigas</i>	191 : 59	3 : 1	0.261	0.50-0.95
4	Normal-leaved	13	Normal : <i>Tiny</i> : <i>Gigas</i> : <i>Fasciculifolia</i>	181 : 41 : 41 : 24	9 : 3 : 3 : 1	7.1	0.50-0.20
5	<i>Tiny-leaved</i>	3	<i>Tiny-leaved</i>	..	..	..	..
6	<i>Tiny-leaved</i>	9	<i>Tiny</i> : <i>Fasciculifolia</i>	104 : 41	3 : 1	0.829	0.20-0.50
7	<i>Gigas</i> -type	6	<i>Gigas</i> -Type	..	..	..	..
8	<i>Gigas</i> -type	5	<i>Gigas</i> : <i>Fasciculifolia</i>	20 : 8	3 : 1	0.190	0.50-0.95
9	<i>Fasciculifolia</i>	2	<i>Fasciculifolia</i>	..	..	..	..

In both cases, the results obtained in the F_3 generation confirm the F_2 findings, thus proving the dihybrid mode of segregation of the two leaf mutations. Thus the true breeding normal-leaved type of *Cicer* could genetically be symbolised as *Slv Slv Tlv Tlv Nlv Nlv Glv*

Glv, the *gigas* type as *Slv Slv Tlv Tlv glv glv*, the *tiny-leaved* type as *Slv Slv tlv tlv Nlv Nlv Glv Glv*, and the *Fasciculifolia* form as *Slv Slv tlv tlv Nlv Nlv glv glv*.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. S. Solomon, Deputy Director of Agriculture (Crop Research), B.S., Poona, and to Dr. R. D'Cruz, Assistant Professor of Botany, Poona Agricultural College, for their kind help and guidance in analysing the data included in the note.

Crop Research Section, B. B. CHAUDHARY.
Dept. of Agriculture, G. P. ARGIKAR.
Bombay State, Poona-5,
September 3, 1957.

- Argikar, G. P., *Jour. Ind. Bot. Soc.*, 1952, 4, 362-69.
- Ekbote, R. B., *Curr. Sci.*, 1937, 5, 618-49.
- , *Ind. Jour. Genet. Pl. Breed.*, 1942, 2, 50-56.
- Singh, H. B. and Bhagchandani, P. M., *Ibid.*, 2, 106-09.

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NEW INSECTICIDES

THE derivatives of chloracetic acid are known to be good contact insecticides. The chloracetyl group readily liberates hydrogen chloride¹ and hence it may be a powerful insect poisonous component according to the theory of Martin and Wain.² Accordingly the chloracetates of various substituted phenols and the corresponding orthohydroxyketones obtained by the Fries transposition³ have been tested for their insecticidal action. Similarly, 2-furoyl group was also considered to be good toxophore in view of the fact that 2-furoates have been found to possess insecticidal activity⁴ and hence various phenyl 2-furoates and the corresponding orthohydroxy 2-furophenones⁵ have also been tested for the same. The insecticidal activity of all the series of these compounds has been reported in this paper.

The testing of the insecticidal activity of the compounds has been done against common house-flies in terms of 50 and 100% knock down. For the sake of comparison of the insecticidal activity of the compounds with standard insecticides, the activities of 2, 2-bis (4'-chlorophenyl)-1, 1, 1-trichloroethane or D.D.T., 1, 2, 3, 4, 5, 6-hexachlorocyclohexane or B.H.C. and pyrethrin under identical conditions have also been recorded. The derivatives of chloracetic acid are found to be the compounds of very high knock down value. Most of the compounds are superior to D.D.T. and B.H.C. A few phenyl chloracetates are about 20 times more active. It appears that the contribution of halogen atoms, attached to the phenyl nucleus, towards the insecticidal activity, is not prominent.

EXPERIMENTAL

Bioassay of the Insecticidal Action.—The testing of the insecticidal activity has been done exclusively against 5 days-old and laboratory-bred common house-flies, obtained from regular test fly colony reared for biological standardisation.

The various compounds were first diluted in mineral turpentine to 1% strength (weight/volume). 0.2 c.c. of the solutions so obtained were sprayed by means of an Aero Spray gun at a predetermined pressure into glass jars, standing on revolving table, covered by mosquito netting and containing 20 test flies per test. Each test was carried in duplicate. The periods required to ensure the dorsal positions of 50 and 100% of the flies exposed to the insecticidal spray were recorded. In two instances when a slow insecticidal activity was noticed the percentage of knock down for 60

minutes was recorded. The results given here are the average of the two experiments. In the control experiments, i.e., spraying of the flies with solvent alone, there was no mortality within the time of observation.

During the testing time the temperature remained 28 to 30°C. and relative humidity 76 to 83%. The results are summarised in Table I.

TABLE I

No.	Compound	50% Knock down	100% Knock down
1	2-bromo phenyl chloracetate	22.0 sec.	96.0 sec.
2	3-ethyl phenyl chloracetate	15.5 "	50.0 "
3	4-bromo phenyl chloracetate	20.5 "	54.0 "
4	2-chloro-4-tertbutyl phenyl chloracetate	2.5 min.	4.5 min.
5	2, 4-dichloro phenyl chloracetate	3.0 "	6.5 "
6	3, 4-dimethyl phenyl chloracetate	2.0 "	4.0 "
7	2-hydroxy-3-bromo chloracetophenone	6.5 "	12.0 "
8	2-hydroxy-4-ethyl chloracetophenone	2.0 "	3.0 "
9	2-hydroxy-5-bromo chloracetophenone	4.5 "	9.0 "
10	2-hydroxy-3-chloro-5-tertbutyl chloracetophenone	20% K.D. after 60 min.	
11	2-hydroxy-3, 5-dichloro chloracetophenone	36.0 min.	55.5 min.
12	2-hydroxy-4, 5-dimethyl chloracetophenone	5.0 "	10.5 "
13	4'-chloro phenyl 2 furoate	1.0 "	2.0 "
14	4'-Bromo phenyl 2 furoate	1.0 "	2.0 "
15	2', 4'-dichloro phenyl 2-furoate	46.0 sec.	56.0 sec.
16	2'-chloro-4'-tertbutyl phenyl 2-furoate	13.5 min.	16.0 min.
17	2'-isopropyl-5'-methyl phenyl 2-furoate	2.5 "	5.5 "
18	3', 4'-dimethyl phenyl 2-furoate	13.5 "	16.0 "
19	3', 5'-dimethyl phenyl 2-furoate	1.5 "	4.5 "
20	2'-hydroxy-5'-chloro-2-furophenone	12.5 "	18.5 "
21	2'-hydroxy-5'-bromo 2-furophenone	11.5 "	17.5 "
22	2'-hydroxy-3', 5'-dichloro 2-furophenone	10% K.D. after 60 min.	
23	2'-hydroxy-3'-chloro-5'-tert-butyl 2-furophenone	18.0 min.	44.0 min.
24	2'-hydroxy-3'-isopropyl-6'-methyl 2 furophenone	1.0 "	2.5 "
25	2'-hydroxy-4', 5'-dimethyl 2-furophenone	3.0 "	9.0 "
26	2'-hydroxy-4', 6'-dimethyl 2-furophenone	2.5 "	6.0 "
	D. D. T.	5.5 "	9.5 "
	B.H.C. (13% gamma isomer)	5.0 "	7.0 "
	Pyrethrin I & II (0.02% solution)	14.3 sec.	34.3 sec.

The authors are grateful to Geigy Insecticides, Limited, Bombay-1, for the help in

carrying out the insecticidal activity of the compounds described in this paper and to Dr. A. B. Sen for his interest in this work.

S. S. TIWARI.

BRAJENDRA NATH TRIPATHI.

Chemical Labs.,
Lucknow University,
Lucknow, October 14, 1957.

1. Fieser and Fieser, *Organic Chemistry*, D. C. Heath & Co., Boston, II Edition, p. 686.
2. Martin and Wain, *Nature*, 1944, 154, 512.
3. Tiwari and Tripathi, *J. Ind. Chem. Soc.*, 1956, 33, 214.
4. Gilman and Hewett, *Iowa State College J. Sci.*, 1932, 6, 439; *Ibid.*, 1933, 7, 419.
5. Tiwari and Tripathi, *J. Ind. Chem. Soc.*, 1954, 31, 841.

ON THE SWIM-BLADDER OF *ANABAS TESTUDINEUS* (BLOCH)

In an account on the genus *Anabas*, Gunther¹ (1861), describes its air-bladder as "bifid posteriorly, each lateral portion extending nearly to the end of the tail". Day² (1889) points out that the air-bladder of *Anabas* is bifid posteriorly with either extremity produced. Regan³ (1909) in an account on the Asiatic Fishes of *Labyrinthici* states that the air-bladder of *Anabas* is divided posteriorly by the hæmal spines which support the basalia of the anal fin. Berg⁴ (1940), in giving the characters of the suborder *Anabantoides*, mentions that the air-bladder is divided posteriorly as in *Ophicephalidae*.

The swim-bladder of *Anabas* consists of three divisions (Fig. 1); first, a narrow thick tubular portion lying in the coelomic cavity; second, a bifid, middle portion in the anterior caudal region and third, a median posterior chamber, occupying the region of the caudal peduncle.

The first division is clearly marked off from the rest by its high vascularity. The retia mirabilia, present only in this region, is in the nature of a few patches and is visible externally through the tunica externa of the swim-bladder. The thickness of this portion may be due to the presence of gas gland, and this zone appears as the gas-secreting part of the swim-bladder.

The second division is that portion of the swim-bladder which lies in the post-coelomic region of the body. As the swim-bladder enters this zone, it bifurcates into two bilaterally-symmetrical tubular limbs at the level of the first hæmal spine. There are thirteen hæmal spines which arise from the hæmal

arches of the vertebrae and are attached to the basalia of the median anal fin. The hæmal spines, interconnected by fibrous connective tissue, form a vertical septum between the two limbs of the swim-bladder. Due to the absence of coelomic cavity here, these tubes find their way posteriorly between the lateral muscles of the body-wall and the hæmal spines. The wall of each lateral limb of the swim-bladder is considerably thin and is covered by loose peritoneal sheath.

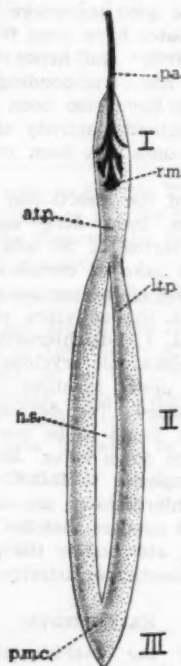


FIG. 1. Ventral view of the swim-bladder of *Anabas testudineus* (Bloch) (Diagrammatic).

a.t.p., anterior tubular portion; h.s., hæmal spine zone; l.t.p., lateral tubular portion; p.a., pneumatic artery; p.m.c., posterior median chamber; r.m., retia mirabilia.

The two limbs of the swim-bladder leave the region of the hæmal spines and enter the caudal peduncle where they reunite to form the median posterior chamber, which is designated as the third division. The median chamber tapers almost to a point where the hypurals join the caudal fin rays.

The present note points out that the swim-bladder of *Anabas* is bifid posteriorly and the two limbs, at the caudal extremity, reunite to form a median posterior chamber. The author⁵ has shown elsewhere that the swim-bladder of

Ophicephalus up to the perforated *Anabas*.

The author is indebted to Dr. I. Dept. of Zoology, University of Delhi, S.

1. Gunther, *Brit. Mus. Nat. Hist.*, 1861, 188.
2. Day, *Fishes of India*, 1889, 3.
3. Regan, *Fishes of India*, 1909, 4.
4. Berg, *Fishes of India*, 1940, 5.
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Ophicephalus is a long, median tube extending up to the caudal region and partitioned by a perforated diaphragm. The swim-bladder of *Anabas* is different from that of *Ophicephalus* and the two are not comparable to each other as described by Berg.

The above work was done in the Department of Zoology, University of Delhi. I am grateful to Dr. Miss M. Chandy for guidance.

Dept. of Zoology, M. G. GEORGE.
University of Delhi,
Delhi, September 17, 1957.

1. Gunther, A., *A Catalogue of the Fishes of the British Museum*, 1861, 3, 374.
2. Day, Francis, *Fauna of British India—Fishes*, 1889, 2, 366.
3. Regan, C. T., *Proc. Zool. Soc.*, London, 1909, 766.
4. Berg, L. S., *Classification of Fishes both Recent and Fossil*, 1940, 485.
5. George, M. G., *J. Zool. Soc., India*, 8 (2) (in press).

**FURTHER RECORD OF OCCURRENCE
OF CRYPTOTERMES DUDLEYI (BANKS)
IN INDIA (INSECTA : ISOPTERA :
KALOTERMITIDAE)**

Cryptotermes dudleyi (Banks), commonly known as the American Powder Post Termite, is known to occur in the neotropical, oriental and Australian regions. From the oriental region, it has been recorded from Ceylon, Java and the Philippines (Snyder¹). Recently, its

occurrence at Khulna in East Pakistan (Chaudhry²) and in Barkuda Island, Chilka Lake (Orissa) [Roonwal and Sen-Sarma³] has also been reported. Further distributional records are: J plot, 30 miles north-east of Nankhana Range Headquarter and Jhingakhali in the Mangrove Forests, Sundarbans in Lower Bengal. It is apparently confined to the coastal region.

This species attacks wooden poles, pillars, doors, windows and all types of bamboo structures. Its intensity of attack is usually of a severe nature and the wooden structures are completely excavated and ruined with galleries. All structures of wood and bamboo constructed near the creeks and rivers in Sundarbans are found to be highly susceptible.

The characteristic damage of these termites is easily detected by the presence of coarse and hard pellets of excreta found scattered on the ground below. These pellets are thrown out from the circular holes made in the wood. Each pellet is more or less oval in shape, having six longitudinal ridges with concave interspaces.

Entomology Branch, P. K. SEN-SARMA.
Forest Res. Institute, R. N. MATHUR.
Dehra Dun, September 28, 1957.

1. Snyder, T. E., *Smithson. misc. Coll.*, 1949, 112, 41-42.
2. Chaudhry, G. U., *Pakistan J. Forest.*, 1955, 5 (1), 40.
3. Roonwal, M. L. and Sen-Sarma, P. K., *Indian J. Agric. Sci.*, 1956, 26 (1), 3-4.

NOBEL AWARD FOR MEDICINE AND PHYSIOLOGY—1957

THE award of the Nobel Prize in Medicine and Physiology to Professor Daniel Bovet marks the success of a great research worker on sulphanamides, antihistamines, and muscle relaxants. Professor Bovet, now aged 50, was born in Neuchâtel, Switzerland, the son of a Swiss psychologist, Pierre Bovet, and is now a naturalized Italian. He graduated at the University of Geneva in 1929, and for nearly twenty years was associated with Professor Fournieu in the Pharmacology Department at the Institut Pasteur, Paris. In 1947, he moved to Rome to become Director of the Pharmacology Department at the Instituto Superiore di Sanità. With others, Professor Bovet studied prontosil in the early 1930's, identifying the sulphonamide group as having

the antibacterial action; they then introduced sulphanilamide into clinical use. He was the first to synthesize an antihistamine compound and did much to develop the range of these drugs that have found such wide application in medicine. Turning from antihistamines to muscle relaxants, Bovet was again successful. His research on compounds with curare-like effects led to the introduction of the short-acting muscle relaxant succinylcholine into modern anaesthesia. He is now investigating the groups of compounds commonly known as tranquilizers. Professor Bovet's wife, Filomena Bovet-Nitti has collaborated closely with him in some of his main researches. (*B.M.J.*, 1957, p. 1045.)

REVIEWS

An Introduction to Reactor Physics. (Second Edition.) By D. J. Littler and J. F. Raffle. (Pergamon Press, London), 1957. Pp. x + 208. Price £ 1-10-0.

There are few books dealing with the subject of Reactor Physics at an elementary level and the first publication of "An Introduction to Reactor Physics" by D. J. Littler and J. F. Raffle in 1955 was most welcome. The appearance of a second edition, so soon after the first, speaks well for the book. The presentation of material has been considerably improved in this edition, and besides, new data declassified at the International Conference on the Peaceful Uses of Atomic Energy held at Geneva in 1955, have been incorporated.

The book is based on lectures given by the authors to a mixed audience of physicists and engineers and as such, the authors devote the first five chapters to discuss the basic ideas of nuclear physics relevant to the study of nuclear reactors. The presentation is clear and should be readily understood by beginners. Reactor theory, with special reference to graphite moderated natural uranium reactor, is discussed in the next seven chapters. Neutron cycle, diffusion theory, calculation of lattice constants and the kinetics of a reactor are dealt with in sufficient detail. However, the theory of slowing down of neutrons has been considered very casually and the physical significance of quantities like 'age', geometrical and material bucklings, has not been sufficiently explained. The book also completely avoids discussing a very important class of reactors, those moderated by water—either light or heavy.

Last three chapters deal with allied topics like radiation damage, shielding and instrumentation. A chapter on the theory of cooling of uranium rods in a reactor would have been a welcome addition.

The book contains a number of numerical examples which help in the understanding of the theory. Formulae and mathematical results have been put in such a form, that they can be directly used for calculations. Apart from the few omissions, the book should be useful to beginners.

K. S. SINGWI.
B. P. RASTOGI.

The Hypercircle in Mathematical Physics. (A Method for the Approximate Solution of Boundary Value Problems.) By J. L. Synge. (Cambridge University Press), 1957. Pp. 424. Price 70 sh. net.

The solution of differential equations with boundary conditions confronts a wide class of scientific workers—physicists, pure and applied mathematicians and engineers. Exact solutions for these are obtainable only in a few cases and with the increasing complexity of the problem, approximations become inevitable. The book under review describes a method for solving boundary value problems of different types that occur in physics and engineering. The method was originally evolved by the author and Professor Prager to solve certain problems of elasticity. Later, finding its contents deep enough to have a wider range of applicability, the author has developed it into a systematic theory for the approximate solution of differential equations satisfying boundary conditions.

In the hypercircle method, the solution of the problem is viewed as a point in a function space; the analytical problem is thus converted into a geometrical one. The geometry of the function space (Chapters I and II) runs on parallel lines to that of the n -dimensional vector spaces though the dimensionality of the former is infinite. The author defines a hyperplane of class n as the set of points (X) satisfying the equations $X \cdot S_p = b_p$ ($p = 1, 2, \dots, n$) where S_p are n linearly independent fixed vectors of the function space and b_p are n fixed numbers, and a hypersphere as a subspace of the function space consisting of all points equidistant from a fixed point. As in the case of ordinary Euclidean geometry, the hypercircle is the intersection of a hypersphere by a hyperplane.

In most problems of mathematical physics, the solutions admit of a geometrical interpretation as the point of intersection of two orthogonal linear subspaces of a function space. In the hypercircle method, the solution is located on a certain hypercircle of a function space and if its radius is small, the solution is chosen as the centre of the hypercircle or any point on it. The accuracy of the method therefore depends on how small the radius of the hypercircle is, and throughout the book the author

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has made efforts to derive bounds between which the solutions can be limited.

The book is divided into three parts. Part I contains an exposition of the basic ideas of a function space. In Part II which occupies by far the major portion of the book, the author develops the geometry of the function space as well as the method of the hypercircle and applies it to the solution of the well-known Dirichlet and Neumann problems. A number of examples of the solution of Laplace's equation under Dirichlet or Neumann boundary conditions are worked out. In Chapter 4, the method is applied to the torsion problem which is of interest to applied mathematicians, and the author discusses the torsion of beams with hexagonal cross-section and the torsion of a hollow square. An interesting account of the variational principles for boundary value problems is given in Chapter V which also contains a discussion and solution of a number of problems that are of importance in relation to the subjects of elasticity and hydrodynamics.

Thus far the theory dealt with spaces having positive definite metrics. In Part II the author discusses function spaces with indefinite metrics of which a familiar example is the Minkowskian four-dimensional space-time metric of special relativity. The contents of this part include the (pseudo) hypercircle method for such metrics and the vibrations of elastic and electromagnetic systems.

An interesting feature of the book is the frequent resort that the author makes to geometrical intuition, by way of expressing abstract themes relating to function spaces as simple generalisations of the well-known theorems of plane or three-dimensional Euclidean geometry. This relaxes the rigours of excessive abstraction and renders the reading of the book delightful. One can hope that the hypercircle method will find increasing applications in years to come. The author and the publishers are to be congratulated for bringing out this book which is a welcome addition to the literature of mathematical physics.

K. S. VISWANATHAN.

Changes of State. By H. N. V. Temperley. (Clever-Hume Press, Ltd., London), 1956. Pp. xi + 324. Price 50 sh.

Recent advances in the field of phase transitions have been rapid and extensive. While experimental data are available in abundance the theoretical work is not free from doubts. Often several theories are in circulation and it is difficult to select one of them as the most

plausible one. An attempt has been made in this book to review these different theories and to point out their shortcomings. The author has also succeeded in weaving a large number of widely scattered original papers into a connected account for each type of transistor discussed.

The text is divided into ten chapters, the first three introducing general aspects of the subject. In the remaining seven chapters the following topics have been reviewed; evaporation and liquefaction, fusion and solidification, solutions, ferromagnetism and antiferromagnetism, ferroelectricity, superconductivity and liquid helium. Considering the aim of the book most of the chapters have been written in sufficient detail, but in the last three chapters, the author appears to be in a hurry. A more detailed critical examination of present theories near the transition temperature of superconductor and liquid helium would have increased the value of book.

The book provides for the first time an up-to-date and correlated account of different types of phase transitions selected from a wide range of topics. It will be a valuable addition to any Physics library.

B. K. AGARWAL.

Mercury and Its Compounds. (Annals of the New York Academy of Sciences, Vol. 65), 1957. Pp. 357-652. Price \$3.50.

In April 1956, The New York Academy of Sciences conducted a Conference on Mercury and Its Compounds and the present volume is the outcome of the papers and discussions presented by a large number of experts working on a variety of problems concerning mercury. The volume consists of three parts, the first part dealing with physics and chemistry of mercury, the second with pharmacology and technology and the third with chemical medicine.

The physics and chemistry of mercury presented in Part I of this volume deal with the historical, physical and electrochemistry of the metal. G. W. Seers who has done valuable work on the mechanism of crystal growth, has discussed the theoretical and experimental methods employed, in understanding the growth of the mercury crystal by the condensation of the vapour. It is suggested that detailed structural studies employing X-ray methods would give valuable information regarding the structure of the mercury platelets and whiskers. The next section deals with the part played by the metal in the development of electronics.

Subsequent sections in this part deal with the recent studies in structural inorganic chemistry of mercury, the oxymercuration of alkenes, physico-chemical rationale for the biological activity of mercury and its compounds and finally the relationship between the chemical structure and biological activity in mercurial compounds. In these sections, a critical account has been given regarding the various theories of the biological activity of the mercurial compounds and how these theories have helped in the discovery of large number of biologically useful new compounds.

Earlier experience with the metal and its inorganic and organic compounds has given mercury, a bad pharmacological reputation which has persisted in the face of rather impressive research indicating that the newer organomercurials are chemically and pharmacologically different from those previously investigated. The detailed reports on renal tolerance, to long-term administration of massive doses of new mercurial diuretics in refractory patients, by various routes described in the second part clearly establish the therapeutic safety and efficacy of the new drugs.

The survey of the literature on dangers involved in the use of paints and fungicides containing mercury on higher plants will be found to be highly interesting and useful to the horticulturists and the biochemists.

An exhaustive discussion, on the mode and mechanism of mercurial diuresis, is initiated in the last part which deals with the rational approach for the therapeutic uses of the organic mercurials. All available evidence suggests the primary cause, to be the inhibitory effect on a number of proximal tubular functions including the reabsorption of sodium and associated anions. Concise but illuminating presentation on the role of mercurials on the congestive heart failure, the outpatient management of cardiac patients with mercurial diuretics, the problems of the management of the refractory patient and the influence of the hormonal mechanism in these refractory patients are facets of study which every practising physician should be acquainted with. An analysis of the biochemical and physiological actions of mercurial diuretics has naturally widened its therapeutic potentialities which now include conditions like preeclampsia, Minière's syndrome, obesity and cardiac asthma.

The book is very well written and very helpful to those who are particularly interested in the technical applications of mercury.

M. R. A.

Aircraft Hydraulics, Vol. I. (Hydraulic Systems.) Edited by H. G. Conway. (Chapman & Hall, London), 1957. Pp. 146. Price 35 sh. net.

This book is the first of a series of text-books published under the authority of the Royal Aeronautical Society and is intended to meet the needs of students and young engineers. The subject of aeronautics has become so complex today that there is need for comprehensive text-books dealing with its various specialised aspects and the Royal Aeronautical Society is doing a signal service to the aeronautical profession by sponsoring the present series of text-books. The first two volumes will deal with hydraulics and a third volume is proposed on landing gear design. Subsequent volumes will no doubt deal with electricals, instruments, etc.

Hydraulics has rightly been given high priority in the series since it represents a very major activity of the industry. In a modern aircraft, flying controls, landing gears, flaps, bomb doors, steering, brakes and other auxiliary services are operated by hydraulics and the science and technology of hydraulic systems and circuits has become an important field. In the present text-book the basic theoretical aspects are dealt with and two chapters are devoted to installation and operation of hydraulic systems. The chapters are written by specialists working in the field and hence are authoritative.

In general, the presentation of the subject-matter is excellent and the book is strongly recommended as a text-book for University courses in aeronautics. It will also serve as a useful reference handbook for young technicians in the industry and as a sound introduction to advanced work in the field. The book will be an indispensable addition to all aeronautical libraries.

P. N.

Introduction to Printed Circuits. By R. L. Swiggett. (Published by John F. Rider Inc., New York.) (Indian Agents: Asia Publishing House, Bombay-1), 1957. Pp. x + 101. Price 21 sh. net.

Printed circuits have made possible a revolution in factories making electronic equipment. They represent an innovation arising out of World War II. Not much of the details has been known to the ordinary radio engineer. But, in view of the part that this development has played in the mechanisation of the electronics industry and the increasing importance, it is likely to assume, in the near future, a knowledge of the technique is most essential

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to all electronic engineers. As such, this book is most welcome.

In a brief span of 101 pages, the author explains most lucidly the origin and growth of the technique, ceramic based printed circuits, etched base printed circuits, plated circuits, etc., the type of components for printed circuits, the method of assembly, servicing, etc., of printed circuits. The presentation of the matter is very systematic. As the book is entirely descriptive, even a very ordinary technician can read and follow the subject-matter without much effort.

The printing and get-up of the book is excellent. The cost of the book, viz., 21 sh. appears apparently to be high, but looking to the quality of the book and the importance of the subject, the price of the book is certainly reasonable.

The book should find a worthy place in all technical libraries.

S. V. CHANDRASHEKHAR AIYA.

Laboratory Manual of Organic Chemistry. By Dey, Sitaraman and Govindachari. (Published by S. Viswanathan, "Action Lodge", McNicol Road, Chetput, Madras-31), 1957. Pp. xiv + 457. Price Rs. 12.

This book was first published by Dey and Sitaraman in 1937. It was well received. The second edition was published in 1941. As for the last few years this book was out of print, and a third edition, revised and rearranged by Dr. Govindachari, has now been published.

The arrangement of the material is almost the same as in previous editions except for some new additions bringing the matter up-to-date. Chapter I describes the simple organic operations in organic chemistry. A brief account of chromatographic method of separation is a welcome addition in this chapter. Chapters II, III, IV and V are devoted to manipulation of small quantities of substances, reaction of common organic compounds and a systematic identification of organic compounds. Chapter VI gives the directions for the preparations of derivatives of substances. Here several new types of derivatives such as the preparation of 3-nitrophthalates for alcohols, dimesone derivatives for aldehydes, S-benzyl thiuronium salts for acids, etc., are included. Chapters VII and VIII are devoted to model analysis of substances and mixtures. Chapter IX gives the preparation of 127 typical organic compounds. The other chapters describe the quantitative estimations of groups and elements (Chapters X

and XI), purification of solvents and preparation of common inorganic substances needed in organic synthesis (Chapter XII) and general manipulations such as simple glass blowing, etc. (Chapter XIII). An Appendix at the end gives valuable data like m.p. of derivatives and densities of acids, etc.

It will be thus seen that the book covers completely the course of practical organic chemistry for B.Sc. (Hons.) and M.Sc. students to whom the present edition will be a boon. The revision has been well done. The diagrams and illustrations are excellent. Even research workers in organic chemistry will find many items of interest in it.

K. S. N.

Phosphorus and Fluorine. (*Some Aspects of the Chemistry and Toxic Action of Organic Compounds Containing Phosphorus and Fluorine.*) By B. C. Saunders. (University Press, Cambridge), 1957. Pp. xv + 230. Price 32 sh. 6 d. net.

The war-time researches, though initiated for the development of newer weapons for the destruction of humanity, have found useful applications for the good of mankind in a few instances. One such project has been the studies on organic compounds containing phosphorus and fluorine. Meant to be developed as agents of chemical warfare, an analysis of the biochemical and physiological properties of these compounds have widened their scope of application. Dr. Saunders, the discoverer of D.F.P. (Di-iso-propyl-fluoro phosphonate), presents in this monograph an authoritative account of the development of these new class of compounds.

The monograph is concerned mainly with two types of organic fluorine compounds, the phosphoro-fluoridates and fluoroacetates. The chemistry and the biological applications of these compounds have advanced very rapidly and in very many directions. Their remarkable biological property as powerful inhibitors of cholinesterase have made them valuable tools in the investigation of enzyme systems. The unfolding of the steps in the development of some of these compounds as systemic insecticides on a commercial scale, originating from the casual observation of the death of the flies in the room by extremely minute quantities of these drugs while studying their toxicity is a fascinating narrative.

Considering the importance of the enzyme systems susceptible to the action of these drugs involved both in the normal neurophysiological processes of the body and in pathological

conditions, it is but natural to expect these compounds to possess wider therapeutic potentialities. That such has been the case is shown by the preliminary reports on the beneficial effects in post-operative paralytic ileus, myasthenia gravis and glaucoma. The property of esterase inhibition which has close relationship with growth inhibition has formed the basis for the experimentation of these drugs in malignant growth and tuberculosis.

Though meant primarily for the advanced students of chemistry and industrial chemists, dealing at length on the synthetic methods, the structure activity relationships and considerations of the chemical reactions of phosphorofluoridates, phosphorodiamic fluorides, the fluoroacetates and other compounds containing C-F linkage, the monograph will be found to be highly useful to the enzymologists, physiologists and pharmacologists who are interested in unravelling the basic principles involved in the kinetics of many enzyme reactions and in the interpretation of the mode of action of drugs.

M. SIRS.

Mitochondria and Other Cytoplasmic Inclusions. (*Symposia of the Society of Experimental Biology*, No. X.) (Cambridge University Press), 1957. Pp. 198. Price 55 sh.

In retrospect, one wonders whether progress in the study of the cytoplasmic component, inappropriately named the "Golgi Apparatus", may not have taken an altogether different course if Cajal's suggestion of naming the argentophil inclusion, accidentally discovered in nerve cells in 1898, by the Italian neurologist, Camillo Golgi, as the "Golgi-Holmgren canals" had been accepted. It would then have been incumbent on the cytologists to follow the path indicated by Duesberg and prove or disprove that the Golgi network and the Holmgren canals are one and the same structure.

The analyses did not proceed in that direction and as legacies we have the sharp disagreements consequent on Parat's formulation of the "Vacuome Theory" and Baker's contention that there is no such thing as the Golgi apparatus or Golgi substance. The Symposium highlights the "Golgi Controversy" (Baker, pp. 1-10).

Baker's contention (p. 7) is nothing new since similar arguments had been presented earlier by Walker and Allen in 1924. The doubt regarding the homology of the Golgi bodies of germ cells to the Golgi nets of vertebrate somatic cells (p. 9) existed even in 1924. Cowdry (1924) comments: "In the present state of our knowledge, it is unsafe to place too much re-

liance in the idea that it (the Golgi apparatus) is strictly homologous in different cells, though within limits which cannot yet be defined it may generally be so." The Golgi bodies reported from living germ cells by Gatenby even before Cowdry's review have no resemblance to the networks seen in vertebrate somatic cells.

Golgi did not see the structure in living cells. But Ludford presented dark ground micrographs of the net-like area in some cells. Nissl was of the opinion that all structures seen in fixed and stained preparations are artefacts. It becomes necessary, therefore, to distinguish between structures which have an existence but are generally invisible from the real artefacts of fixation.

Serious students never tried to produce a Golgi net in germ cells and hence Baker's criticism that "those who introduced the current Golgi techniques were striving to obtain networks resembling those produced by Golgi in nerve cells of vertebrates" (p. 2) is not an accurate diagnosis of the trends in the field.

According to Nissl's dictum, Lacy and Challice ("The Structure of the Golgi Apparatus in Vertebrate Cells Examined by Light and Electron Microscopy", pp. 62-91) have produced only "Aequivalentbilder" and since these are not based on a study of the reactions of visible structures in living cells to fixatives and stains, their arguments and conclusions while interesting are not entirely convincing. There is also a lack of appreciation of the work of earlier investigators on the question of the homology of the chromophobic component of the Golgi apparatus of vertebrates and invertebrates.

The contribution of Dalton and Felix ("Electron Microscopy of Mitochondria and the Golgi Complex", pp. 148-159) is stimulating in that they proceed to study the structure of the Golgi apparatus after demonstrating it in living cells.

Since the Golgi controversy stems from the invisibility of this cytoplasmic component in the living cells in the form in which it is revealed in fixed preparations, the paper by Barer and Joseph ("Phase and Interference Microscopy in the Study of Cell Structure", pp. 160-184) emphasizing the importance of protein media of different refractive indices for study of living structure assumes an unusual significance.

Demonstration of Golgi bodies and nets in living cells and their isolation if possible by differential centrifugation of homogenized cells

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The Symposium contains also equally interesting papers on "Sarcosomes" (Slater), "Cytoplasmic Particles of Plant Roots" (Chayen and Jackson), "Cytoplasmic Inclusions of the Snail Amoebocyte" (Crawford), "The Fine Structure of the Protozoan *Spirostomum ambiguum*" (Randall), "Biochemical Heterogeneity of Cytoplasmic Particles of Rat Liver" (Novikoff), and "The Enzymic Heterogeneity of Cell Fractions Isolated by Differential Centrifugation" (Christian de Duve). Biochemists will find Green's paper on "Organization in Relation to Enzymic Function" of remarkable interest.

M. K. SUBRAMANIAM.

Discovery Reports—Hydromedusae. By P. L. Kramp. (Cambridge University Press), 1957. Pp. 128.

This book issued by the National Institute of Oceanography as Volume 29 of the *Discovery Reports*, covers a monograph on the hydromedusae from the discovery collections made by P. L. Kramp of the Zoological Museum, Copenhagen, Denmark.

Of the 25 species of Leptomedusae, a species of Limnomedusae, 22 species of Trachymedusae and 15 of Narcomedusae described, 6 species and 1 genus et species constituting a family of anthomedusae, are new to science. Even with reference to the remaining 68 old species described, the author's observations extend our knowledge of the morphology of several forms and aid the revision of species belonging to the narcomedusan genera *Pegantia*, *Solmissus*, *Cunina*, and the Trachymedusan genus *Arctapodema*. The author has given notes on the asexual propagation of *Bougainvillea platygaster* and commensal larvae of four species of Narcomedusae.

As anyone familiar with the studies of medusae will know, the most important section of the monograph is the one on zoogeographic discussion. A considerable number of the neritic species of Leptolina are Antarctic or sub-Antarctic and have a circumpolar distribution. A similar number belong to warm or temperate waters, and have an extensive north to south distribution with a restricted East to West distribution.

Of the Trachylina, except three Atlantic species, the rest are widely distributed and of the twenty collected by the *Discovery* only two, which are eurythermal, penetrate into the Antarctic region. The bathy pelagic species of both Leptolina and Trachylina are cosmopolitan, in the deep parts of the ocean. Several occur in the warm deep water of the Antarctic

region; but some species require a slightly higher temperature. Thus this report on Hydromedusae with its mass of data will form a useful source book, for the study of this group, as well as of general distribution of pelagic fauna.

C. P. GNANAMUTHU.

Books Received

Common Medicinal Plants of Darjeeling and the Sikkim Himalayas. By Dr. K. Biswas. (Government of West Bengal, Commerce and Industries Department of Cinchona, West Bengal), 1956. Pp. vi + 157. Price Rs. 7.

Advances in Pest Control Research, Vol. I. Edited by R. L. Metcalf. (Interscience Pub., 250, Fifth Avenue, New York 1, N.Y.), 1957. Pp. vii + 514. Price \$11.00.

The Leukemias: Etiology, Pathophysiology and Treatment. Edited by J. W. Rebuck, F. H. Bethell and R. W. Monto. (Academic Press, N.Y.), 1957. Pp. vii + 711. Price \$13.00.

Annual Review of Biochemistry, Vol. 26. Edited by J. Murray Luck, Frank W. Allen and Gordon Mackinnney. (Annual Reviews Inc., Palo Alto, California, U.S.A.), 1957. Pp. ix + 768. Price \$7.50.

Rice in India. By R. L. M. Ghose, M. B. Ghatge and V. Subramanyan. (Indian Council of Agricultural Research, New Delhi), 1956. Pp. x + 507. Price Rs. 21.

Electrical Discharges in Gases. By F. M. Penning. (Philips Tech. Library, Eindhoven; Philips Elect. Co., Ltd., 7, Justice Chandra Mehtab Road, Calcutta, India), 1957. Pp. viii + 78.

Solvents. Seventh Edition, Revised. By T. H. Durrans. (Chapman & Hall, London) (Asia Publishing House, Bombay-1), 1957. Pp. xv + 244. Price 30 sh.

Advances in Nuclear Engineering, Vol. I, Part 1 and Vol. II, Part 2. Edited by J. R. Dunning and B. R. Prentice. (Pergamon Press, London), 1957. Pp. vii + 523 and Pp. vii + 581. Price £7 7 sh. each.

International Series of Monographs on Nuclear Energy, Div. II, Vol. I. Neutron Cross-Sections. By Donald J. Hughes. (Pergamon Press, London W. 1), 1957. Pp. x + 182. Price 30 sh.

Dry Battery Receivers with Miniature Valves. By E. Rodenhuis. (Philips Tech. Library, Eindhoven; No. 7, Justice Chandra Mehtab Road, Calcutta), 1957. Pp. viii + 240. Price 32 sh. 6 d.

Muscular Contraction. By Graham Hoyle. (Cambridge University Press, London N.W. 1), 1957. Pp. viii + 147. Price 15 sh.

SCIENCE NOTES AND NEWS

Sunspot Activity

The 'sunspot number' which is a measure of the number and size of disturbed areas on the Sun was 244 for September and 263 for October. These are the highest recorded figures in two centuries which are available. The previous highest recorded figure was 239 in May 1778 and only on three other occasions has the number been over 200: 206 in December 1836, 201 in May 1947, and 203 in November 1956.

The recent high sunspot numbers have been due mainly to the occurrence of large numbers of small- and medium-sized spot groups. On many days in September and October there have been twenty or more of such groups visible on the disk at one time. There have been few very large groups in 1957; and another unusual feature has been the continued appearance of occasional spots in high latitudes of the Sun.

September also provided a record in terrestrial magnetic activity: there were in all six great magnetic storms with sudden commencements, beginning on the 2nd, 4th, 13th, 21st, 22nd and 29th. Each of these storms could be attributed to the occurrence of an active solar region in position near the Sun's central meridian at the time.

In September there were many disturbances of the ionosphere caused by solar flares. Many of these produced severe radio fadeouts on frequencies of 18 Mc/s. and below. Reception from N. America was particularly disturbed, especially during the large magnetic storms referred to above.

Although the sunspot number for October exceeded the high value in September, active solar regions were less pronounced and their terrestrial effects were on a greatly reduced scale.

A New Ferroelectric Material

Progress continues to be made with both methods and materials for the storage of digital information. Recently the Massachusetts Institute of Technology made use of superconductivity in a storage element called a 'crytron' which occupies little more than 0.01 cm. per binary digit (bit). Now the Bell Telephone Laboratories, New York, have announced a new ferroelectric material, triglycine sulphate, particularly suited to switching and storage. Its

coercive electric fields is 220 V./cm., only one-fifth that of either barium titanate, the most widely studied ferroelectric material, or guanidinium aluminium sulphate hexahydrate (G.A.S.H.) a material described earlier by the Bell Telephone Laboratories. The Curie point of the new material is 47°C. (that of barium titanate being about 120°C., and of guanidinium aluminium sulphate hexahydrate not less than 200°C.), but can be raised to 60°C. or more by substituting deuterium for some of the hydrogen atoms. Switching times of a microsecond or two, such as have been realized also with barium titanate, are claimed (guanidinium aluminium sulphate hexahydrate responds much more slowly). Triglycine sulphate does not show the fatigue found in barium titanate after repeated switching, and will retain its polarization for long periods. When a wafer, 1 cm. square and 0.02 cm. thick, has a set of ten parallel strips of metal evaporated on to each of its two large faces. One set at right angles to the other, it can store 100 bits and be driven and read by circuits using transistors. The material is chemically stable, does not decompose on exposure to the air, and can be handled in thin sheets—three valuable secondary properties. (*Nature*, July 6, 1957.)

The Converatron

At a Meeting of the American Nuclear Society, on October 29, Dr. Lyle B. Borst, Chairman of the Department of Physics, College of Engineering, New York University, described a new design for nuclear power plants. Dr. Borst envisaged a subcritical reactor controlled by a small neutron source and amplified by a 'converatron'. This is a neutron amplifier which magnifies the flow of neutrons in a manner analogous to that of the thermionic valve and the transistor. A series of converatrons would amplify neutron from a weak source to a large power reactor, and yet the power plant itself would shut off upon the removal of the source. Because all parts are subscribed, there is no danger of losing control of the chain reaction.

The converatron consists of three sections—one containing the pure neutron moderator such as plain water or graphite, one containing unenriched uranium-238, and a thermal neutron

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barrier such as cadmium. Fast neutrons from the fission of uranium in the fuel zone penetrate the cadmium barrier. They are slowed by the moderator to become thermal neutrons that activate the next fuel zone. The fast neutrons starting in the reverse direction are slowed by the moderator until they can no longer penetrate the cadmium. Each fuel zone receives neutrons from the preceding stage. Therefore each succeeding stage can operate at a higher power while still depending upon the preceding stage for its excitation. With several stages, the convergatron, acting as a power source through heat transfer, should be able to generate enough power to make the system practicable.

Wax-Electrolyte Batteries

A fundamental investigation of the chemical and electrical properties of batteries made with solid wax electrolytes is now under way at the National Bureau of Standards. This new field of battery research is expected to provide information of value not only in fabricating batteries but also in understanding the phenomena that takes place in wax-electrolytes subjected to electric fields. The study is being conducted by Dr. R. E. Wood of the Electrochemistry Laboratory, at the request of the Dimond Ordnance Fuze Laboratories, Department of the Army. The immediate objective is to obtain information that can be used in constructing batteries for specific ordnance applications.

New Way of Transmitting Speech

The Philips Laboratories at Eindhoven have developed a system of transmitting speech in telecommunications which makes it intelligible even when the distance of the receiver is such that the strength of the background noise is 40% of the signal strength, or about four times as great as that tolerable in conventional systems.

The "Frenac" system, as it is called, transmits information only about the frequencies present in the speech sounds. Surprisingly perhaps, the intensity of the speech sound at each frequency is much less important if the speech is merely to be intelligible and it is left out of the signal altogether. There is merely a "pilot" signal which indicates that speech is in fact being transmitted.

Noise is suppressed at the expense of distortion of voice quality, but for mobile radio stations this may not matter very much. Ex-

periments are continuing in the hope that, in less severe conditions of noise, the Frenac system and its parent Frena system can be adopted to give better than minimum quality. The work is described by Jager and Greefkes in *Philips Technical Review*, Vol. 19, p. 73.

Medical Diagnosis through Ultrasonics

Investigations on Ultrasonic visualization of biological tissues and ultrasonic diagnosis of brain tumour, breast tumour, and gallstones have been reported earlier. In a recent issue of *The Journal of the Acoustical Society of America*, medical applications of megacycle ultrasound to the early cancer diagnosis by means of pulse method has been reported. Echoes have been obtained from human intracranial ventricles, brain tumours, abdominal tumours, gallstones, and breast tumours. As a special finding, the authors report pulsating echo from the intracranial ventricle wall. Delicate bowel movement and rhythmical heart motion could also be observed by ultrasonic waves.

Ultrasonic attenuation varies, depending not only on the changes in the pathological states such as neoplasma or brain-edema, but also to changes in the physiological condition such as anesthesia. Of particular interest is the attenuation decrease and the echo oscillation, found in patients suffering from epilepsy.

Ultrasonic experiments of this nature were carried out with the apparatus of A-scope indication type, as well as that of the plan position indication type, named ultrasono-tomograph. A time position-indication type was also introduced to observe the motion of the organs in the living human body.

Records of bones in human arm have been obtained at a frequency of 1 MC with an ultrasonic scanner and recorder system. The ultrasonic waves discriminate between flesh and bone and such a discrimination is converted into varying electrical responses and recording is accomplished by a helix recorder which writes on electrosensitive paper.

Ultrasonic methods of diagnosis is promising and may become a very useful diagnostic tool in the hands of medical men of the future.

Plasmin

A research team at Yale University has described significant progress in purifying a plasmin enzyme that dissolves blood clots. Plasmin has been tested successfully on animals and that preliminary tests on human patients are now under way.

In human patients, plasmin will be injected into the blood stream as soon as the blood clot is detected. The clot, judging from the animal experiments, should dissolve and the blood return to normal within a few hours. While there are drugs that help prevent the formation of blood clots, up till now physicians have had no drugs that will dissolve a clot once it has formed.

The big problem with plasmin, however, is purification. Plasmin is derived from the interaction of two other enzymes, plasminogen and streptokinase. Plasminogen is an inactive enzyme extracted from human blood. To activate plasminogen and form plasmin, streptokinase is needed. This enzyme is obtained from streptococcal bacteria that contain toxic materials which lower the supply of blood to the heart muscle, lower blood pressure, and cause chills and fever. Although the investigators at Yale have not yet achieved 100% purification of plasmin, they feel that they have found a method for removing enough of its toxic material to warrant tests on human patients.

Deccan Geological and Mining Society

The above Society has been formed at a Meeting convened by Geologists and Mining Engineers on 25th October 1957, at Hyderabad. The following Office-bearers have been elected: *President*: Shri Syed Kazim; *Secretary*: Dr. S. Balakrishna; *Treasurer*: Prof. H. S. Seshagiri Rao.

A Physics Seminar at Calcutta

Under the auspices of the University Grants Commission, the University of Calcutta arranged a Physics Seminar on September 9, 10 and 11, 1957. Twenty papers on Nuclear Physics and Cosmic Rays were read and discussed. Dr. P. C. Bhattacharya, Head of the Department of Physics, Calcutta University, welcomed the guests. Dr. D. M. Bose, Director, Bose Institute, Calcutta, in his Presidential Address, discussed the feasibility of devising a satisfactory syllabus for the Universities and stressed the importance of encouraging nuclear research and training in Universities.

Dr. Buechner from MIT who participated in the Seminar pointed out that Universities should be the prime centres of research and lead in

this matter other research organizations, as post-graduate teaching and research are inter-linked and the one is so essential to the development of the other.

Symposium on High Polymer Qualities of Cellulose Fibre

The Technological Research Laboratories of the Indian Central Jute Committee, Tollygunge, Calcutta, was the host to an one-day Symposium on the above subject held on September 25, 1957. The Meeting was attended by many leading workers on jute fibre including chemists from IJMARI, Jardine-Henderson Group Laboratory, Indian Association for the Cultivation of Science and others. Dr. P. B. Sarkar inaugurated the Symposium and Prof. S. R. Palit was in the Chair.

Papers were presented touching up on the structure and physical properties of jute studied by X-ray methods, cellulose, hemicellulose and lignin—their association in wood and bast fibre and other properties of jute. The papers were followed by lively discussions.

Raptakos Medical Fellowships

The Raptakos Medical Research Board Fellowships for the year 1958 have been awarded to the following candidates: (Miss) Shahi Bala Prasad, Department of Pathology and Bacteriology, K. G. Medical College, Lucknow, Shri Kshitish Chandra Das, Institute of Post-Graduate Medical Education and Research, Calcutta-20, Shri Syed Hasan Majid, Department of Surgery, Patna University, Patna, Shri Anil R. Sheth, Indian Cancer Research Centre, Parel, Bombay-12.

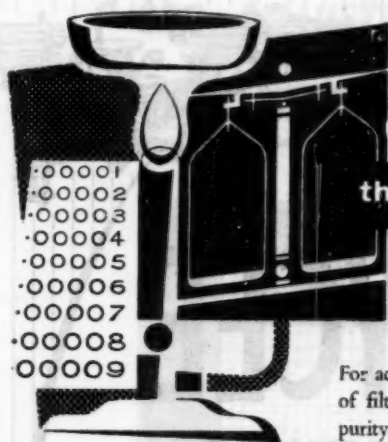
Society for Cell Biology, Liege (Belgium)

Dr. B. R. Seshachar, Head of the Department of Zoology, Central College, Bangalore, has been elected as a Member of the International Committee of the Society for Cell Biology.

Award of Research Degree

Miss Saraswathi Royan, Section of Cyto-genetics, Indian Institute of Science, Bangalore, has been awarded the Ph.D. Degree in Botany of the University of Bombay for her thesis entitled, "The Structure of the Nucleus in *Saccharomyces cerevisiae*".

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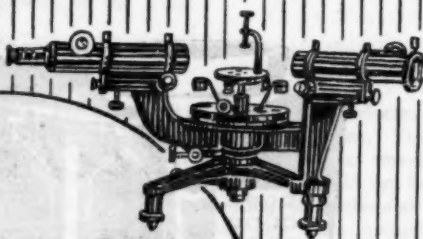
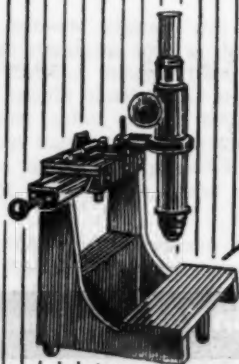
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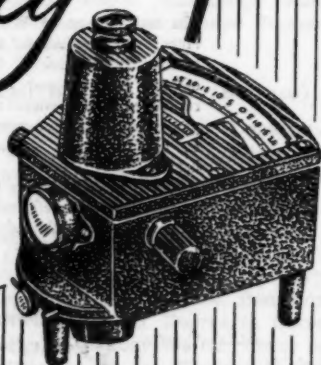
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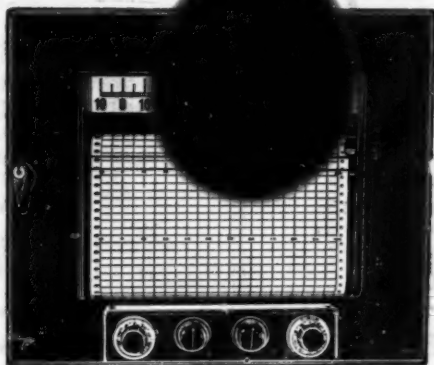
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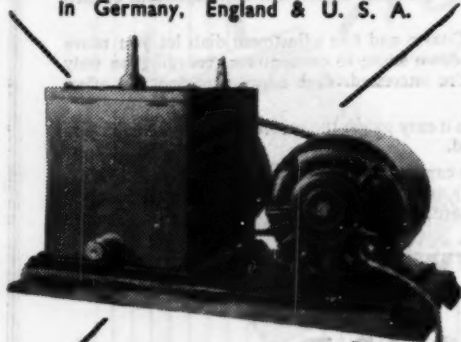
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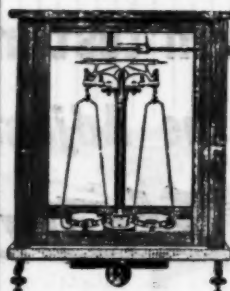


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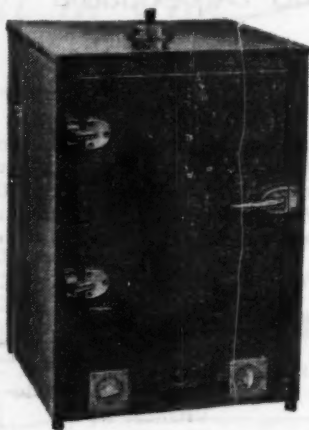
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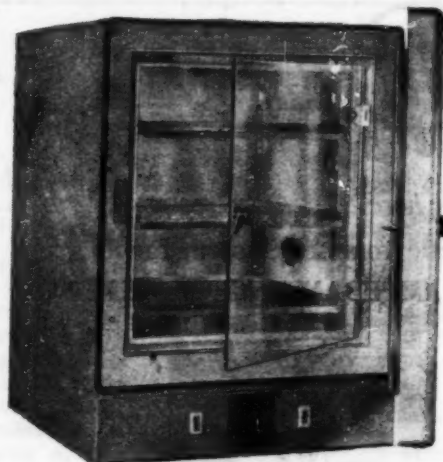
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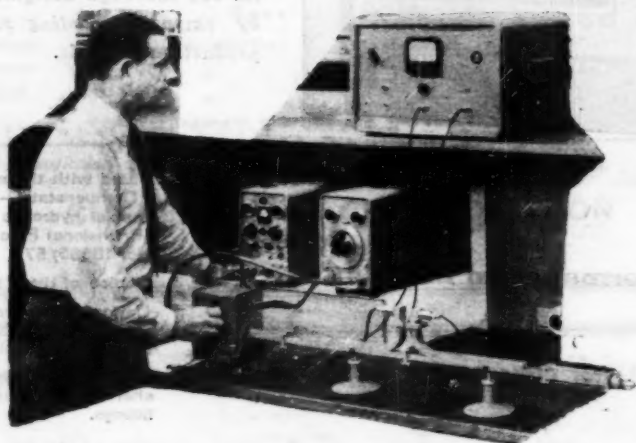
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